

Title COLOR RESPONSES OF THE PUPIL AND BRAIN OF A MONOCHROMAT

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Left Column

Congenital so called Cone Monochromat color blindness is a rare (less than 1 in 100,000) combination of total color blindness with otherwise normal vision. In such a subject pupils were found surprisingly to react in certain respects normally to color changes invisible to the subject while an abnormal absence of visual evoked potentials of the brain was found. Clearly, color was "sensed" by this subject but not seen.

Colored light was projected on a screen from two or more projectors. Pupils were measured with a Lowenstein pupillometer and evoked potentials according to Clynes rosette method.¹ Pupillary contraction in response to marked color changes at constant intensity was found. Responses to intensity change showed an abnormally large "proportional" component. The paradoxical pupillary contraction² found on removal of a color component was present normally (Fig.1). Visual evoked brain potentials on the other hand of this same subject were normal to changes of light from previous black, but quite absent for changes in color which normally evoke the largest responses³ (Fig.2).

The subject, a 45 year old healthy male, was found over a two-year period to have normal sensitivity and acuity throughout the visible range, normal night vision, and appears to have better than normal sensitivity towards the infrared. Parents are dichromats. Color blindness of the subject dates from birth or infancy. Subject's symptoms were clinically not found to be hysterical. He is able to see some light through infrared filters Wratten No. 89B which are not transparent to the normal eye (on the blue and red end of the spectrum). Although unable to match primary colors, he could nevertheless match shades of orange, using variable amounts of green and red light. After-images behaved normally with respect to time course and structure, but in lieu of color changes and inversions showed corresponding regions of greater or less brightness.

Right Column

In the normal pupil response two separate channels of color and intensity are also observed in the simultaneously superimposed characteristic contraction and dilation of different time courses for a color change to lower intensity. The rare combination of total color blindness with normal visual acuity and sensitivity is an exceptional opportunity to study aspects of two separate biologic channels of data processing--color and intensity.

A traditional interpretation of cone monochromat color blindness as resulting from having one type of cone or pigment instead of three does not appear to be justified. We should rather look for a better understanding of the two different data processing channels of color and intensity and recognize that receptor networks may be able to sense intensity normally while not transmitting color information, and that color information may not be processed appropriately at the higher levels. Supp. by NIH Gr. No. NB06124, FB5651
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