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THE RELATIVE NUMBER OF L AND M CONES DETERMINES PROPERTIES OF CHROMATICALLY-OPPONENT RECEPTIVE FIELDS.

Carol M. Cicerone and Anoop K. Mangalick.
Dept. of Cognitive Sciences, University of California, Irvine, CA 92717

A primary signature of chromatically-opponent cells is the cross-over or null wavelength, the transition between wavelengths to which the cell responds with an increase in firing rate and those to which it responds with a decrease. Chromatically-opponent cells have been thought of as the physiological basis for human color vision, largely because these cross-over points can be qualitatively linked to color perception, in particular the unique hues. Previous workers (e.g., Young and Morrocco, 1989; Lennie, Haake, and Williams, 1991) have considered models of chromatic opponency involving random connections to cones. We report here results of a computer simulation of such chromatically-opponent cells whose inputs are derived from random connections to cones in mosaics composed of a range of ratios of L and M cones. Our model for fovea centralis is based upon (1) L and M cones, in a specified ratio, randomly placed in a hexagonal array; (2) receptive fields whose centers are provided by a single cone and whose surrounds are provided by all cones, within a 6-cone radius; (3) relative strengths of the centers versus the surrounds similar to those for LGN parvocellular cells (Derrington and Lennie, 1984). We show that the relative number of L and M cones directly influences the cross-over point of red-green, chromatically-opponent cells. Furthermore, we link psychophysical measurements of the L to M cone ratio and unique yellow in 7 observers with the chromatically-opponent responses of our simulated cells to show that these cells can form the basis of unique yellow judgements in human observers.

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