Is human color perception complementary or opponent? | IOVS

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Is human color perception complementary or opponent?

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Abstract

Purpose : It is well established that the perception of color in afterimages is complementary to the inducing color (Newton), and is often assumed that the complement is defined by the opponency of the red/green and yellow/blue opponent mechanisms (Hering). However, the two concepts make strikingly different predictions that may be tested with the color appearance of afterimages. In terms of complementary colors, the complement of red is not green but cyan (aqua), the complement of green is not red but violet (magenta), and complementary colors sum to achromatic white/gray, whereas red and green (lights) sum to yellow, not a neutral color.

Methods : To assess afterimage colors, patches of red, green, blue, red+green, red+blue, and green+blue spanning the color gamut of a display monitor were viewed on an equiluminant background for 10 s to the left of fixation and replaced in repeated cycles with a blank comparison patch to the right for 2 s, which was adjusted in hue, saturation or intensity to match the afterimage at left. The test patches were set to perceptual equiluminance to the low photopic red patch at 45 cd/m2.

Results : Highly saturated afterimages were obtained under most conditions (see figure). They confirmed the complementary prediction and were clearly distinct from the opponent process prediction, with the image/afterimage connecting lines all intersecting at the neutral point of the color space. Two saturation anomalies were that the saturated cyan and yellow tests generated markedly desaturated red and blue afterimages. This truncation of the afterimage gamut matches a prediction derived from a model of afterimages as linear depletion in cone signals defined according to the CIE Uniform Chromaticity Space.

Conclusions : The complementary organization of the color afterimages is consistent only with adaptation in the individual cone pathway. implying no role for opponent process adaptation in color afterimages. At thesenon-bleaching intensities, the underlying molecular depletion must be occuring after quantal absorption, such as in phosphodiesterase depletion in the cone outer segments or transmitter release at the cone pedicles.

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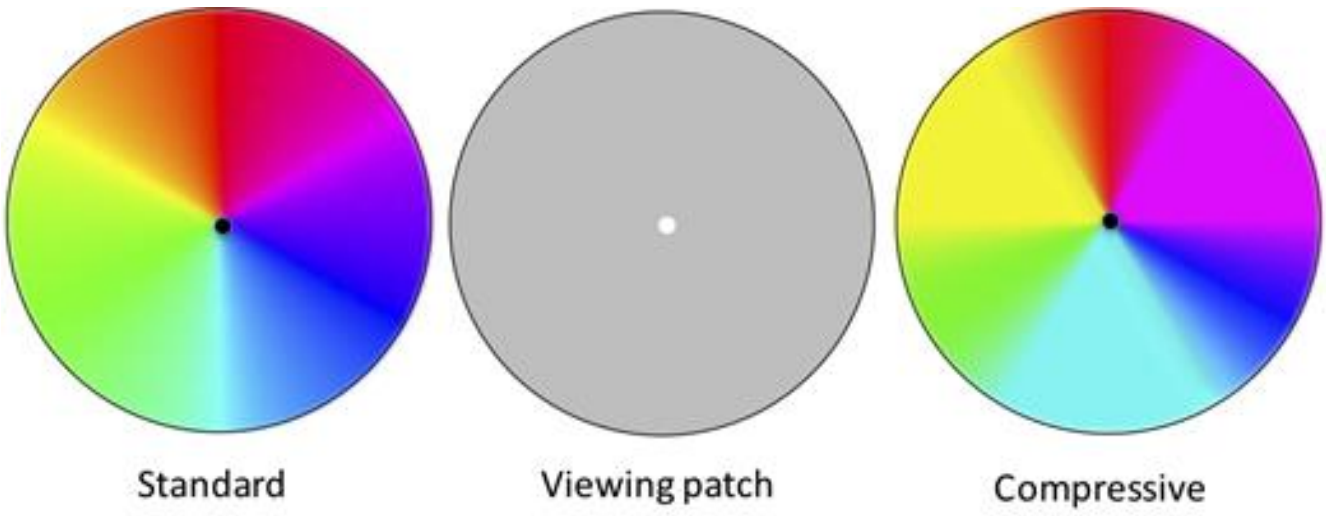

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Standard and contrast-compressed versions of the color circle, with a central test disk for viewing their afterimages by fixating one of the black dots for 10-20 seconds, then transferring fixation to the center disk. View as large as possible for optimal effect.