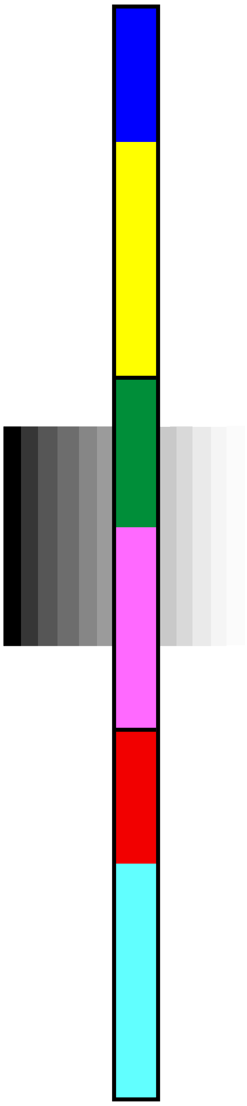

Roles of Complementary Colours in Colour Perception

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DECLARATION BY CANDIDATE

I state that this thesis has not been submitted for a higher degree to any other university or institution.

Ralph W. Pridmore 1 May 2008

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SUMMARY

Complementary colours have been studied in science for over 300 years but little is known of their role in colour vision. Complementary colours are defined as a pair of colour stimuli which, with appropriate complementary wavelengths and ratios of radiant powers, admix a selected white (e.g. that of the illuminant). The thesis aim is to find and describe roles of complementary colours in colour perception. Only one role is generally accepted in the scientific literature: a colorimetric role in colour mixture and matching. A second role, in chromatic induction, was widely accepted until (erroneously) usurped 50 years ago by the opponent colours theory of chromatic induction. This thesis stemmed from signs that the visual system structures various visual functions from complementary colours.

Complementarism is shown to structure ten functions. For six of the functions, math models are formulated from complementary colours. The first three, closely related, papers describe three roles in colour constancy (see Appendix: Definitions), hue cycle structure, and hue cycle relative wavelength metric. Paper 1 describes complementary wavelengths' central role in a spectral mechanism of colour constancy, where constant hue and its complementary constant hue form parallel straight lines. Paper 2 establishes the roles of complementary colours in forming hue cycle structure and its wavelength-based metric. Dominant wavelength is extended into the nonspectrals/purples to form a *relative wavelength* scale over the whole cycle. Paper 3 utilises this scale to extend Paper 1's spectral mechanism of colour constancy into the nonspectrals to complete the global mechanism. Paper 4 argues that chromatic induction is governed by complementary colours rather than opponent colours. Paper 5 formulates math models for six roles, in chromatic induction, wavelength discrimination, uniform hue, spectral sensitivity, saturation, and chromatic adaptation, from the ratio of *either* complementary wavelength intervals *or* of complementary powers; a seventh role, in three-dimensional color discrimination, is described. The total eleven varied roles (including the known colorimetric role) have a wide influence over the visual process from cones to cortex. These discrete roles indicates an overall role of complementary colours is structural, in shaping functions to a trimodal framework (RGB peaks and complementary CMY troughs), whose implicit purpose is to adapt functions to the illuminant. Thus, it is concluded the general role is colour constancy.