Psychology of Perception
Psychology 4165, Section 100
Fall 2002

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MUEN D-156, 9:30–10:45, T & Th

Homework 2: Color Vision
20 Points: Due at beginning of class, Thursday, 31 October 2002

There are two parts to this homework assignment. Each part counts 10 points. Late homework will receive a grade of zero.

Part 1: Three colors are each matched by the following three color equations using the C.I.E. Tristimulus primaries:

$$C_1 \equiv 0.45X + 1.05Y + 0.50Z$$
$$C_2 \equiv 1.35X + 3.15Y + 1.50Z$$
$$C_3 \equiv 3.20X + 1.85Y + 0.95Z$$

Compute the chromaticity coordinates of each color (small x, y, and z). Construct a chromaticity graph by plotting x-chromaticity against y-chromaticity (make the axis scales go from 0.0 to 1.0). Compare the chromaticity of the three colors: are they the same or different? Will these colors exactly match each other in appearance? If not, how do they differ? Finally, what C.I.E. primaries X, Y, and Z, will match the color C_4 produced when C_2 is added to C_3? Plot C_4 on your chromaticity graph.

Part 2: There are three processes in color vision: two chromatic channels and one achromatic channel. These three processes receive input from the three types of cones according to these three equations:

$$(+r - g) = 1.89L - 2.79M + 0.45S \qquad \text{Red - Green}$$
$$(+y - b) = 0.85L + 0.22M - 1.72S \qquad \text{Yellow - Blue}$$
$$L = 0.85L + 0.15M + 0.015S \qquad \text{Luminance}$$

where S, M, and L are the short, medium, and long wavelength cone types. Assume that two colors activate the cones by the following amounts:

	L	M	S
C_5	22.0	8.8	2.2
C_6	5.0	20.0	5.0

Make a graph of the opponent process color space with the x-axis representing (+r–g) and the y-axis representing (+y–b). The scales should run from -50.0 to +50.0. Compute the activation of the three channels to C_5, to C_6, and to a mixture of C_5 and C_6 ($C_5 + C_6$). Plot each of the three colors as points on the graph (C_5, C_6, and C_5+C_6). What is the color appearance of C_5 and of C_6? What is the color appearance of the mixture of C_5 and of C_6?