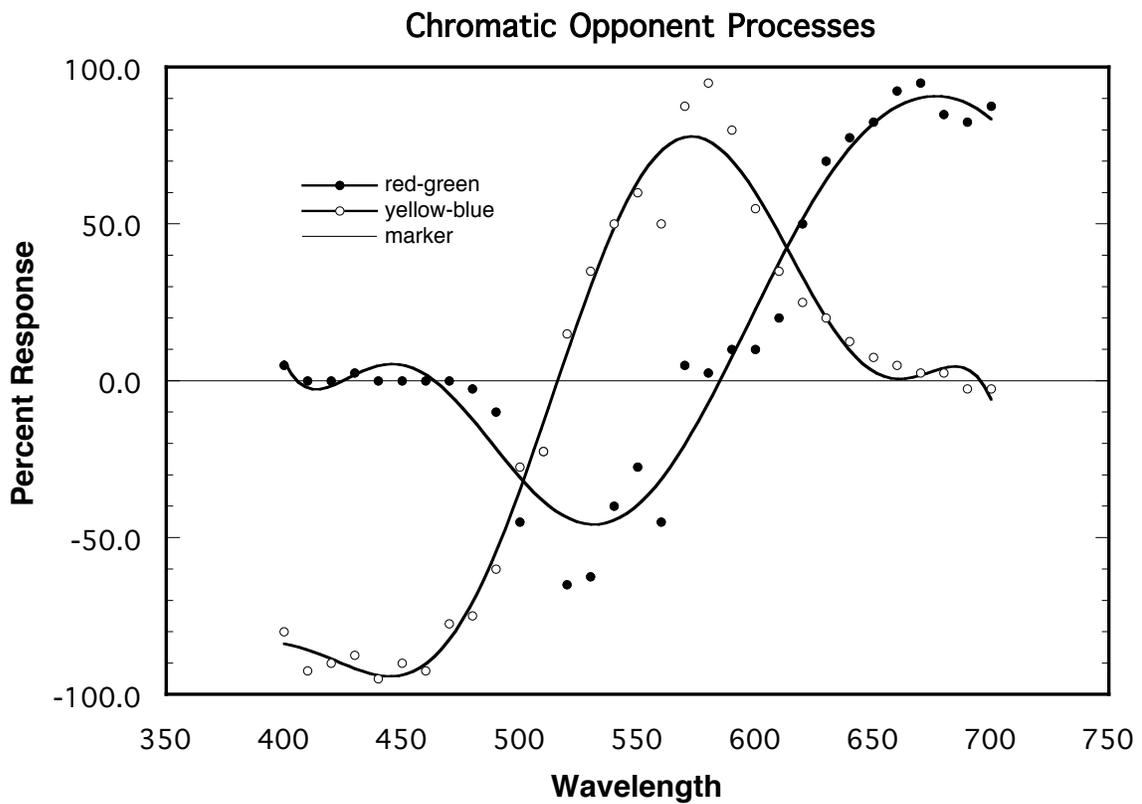


Psychology of Perception

Psychology 4165, Fall 2004

Laboratory 3

Hue-Naming Functions



Psychology of Perception
Psychology 4165-100
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MUEN D-156, 9:30–10:45 T & R

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Introduction

Color is a psychological experience composed of at least three psychological dimensions: **hue**, **saturation**, and **brightness**. Hue is the experience that we describe with color name labels such as red or blue. Saturation describes the intensity of the hue experience, ranging from hueless to deeply saturated. Pink, for example, is a desaturated red. Brightness is the dimension of experience that permits us to order colors from dark to light. Yellow usually appears brighter than navy blue. In this experiment you will explore the color dimension of hue and gain some insight into the perceptual mechanisms that create it.

Physical light is composed of discrete packets of energy called quanta. A quantum of light has only a single physical property that can be described in one of three ways: By the energy in the quantum; by the frequency of the quantum; or by the wavelength of the quantum. Quanta having wavelengths in the range of approximately 400 to 700 nm (1 nanometer = 10^{-9} meter) are called photons because, under the right circumstances, they can lead to visual experiences. Light has no color; color is an experience created by the visual system in response to stimulation by light.

There are hundreds of different color names in English and most languages. In spite of the plethora of color words, people with normal color vision can describe almost all colors as being composed of various percentages of red, yellow, green, and blue. For example, one might describe orange as being 60% red and 40% yellow or lime as 70% green and 30% yellow and so on. In this experiment you are going to view monochromatic lights (light composed of a single wavelength) and estimate the percentage of red, yellow, green, and blue making up the color experience you have of each light.

Methods

Procedure: Form groups of 2 or 3. Each will view monochromatic light projected on a white screen by a Bausch and Lomb monochromator. Thirty-one separate wavelengths ranging from 400 nm to 700 nm in 10 nm steps will be viewed. These wavelengths should be presented in a random order. Record the size of the colored spot and your viewing distance from it. Viewing distance should remain constant throughout the experiment.

Present each of the 31 wavelengths one at a time. On each trial, write down on your data sheet (see Appendix I) what percentage of the color experience evoked by the wavelength is red. Write down 0 percent if there is no red in your experience.. This task may seem very strange at first. You might want to practice a bit before you start in earnest. After all 31 wavelengths have been judged for their redness, repeat the process for yellow, then for green and finally for blue. Be sure to judge all 31

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wavelengths for a given color before moving on to the next color. Use a different random order of the wavelengths for each color judgment.

After you have collected the color naming data above, use the method of adjustment to determine the wavelength that gives you the psychological pure colors of blue, green, and yellow. If you have a dichromatic color deficiency, find the wavelength that appears hueless or neutral white or gray. Record these wavelengths on your data sheet.

Data Analyses: For each wavelength, add up the percentages of red, yellow, green, and blue. Transfer your data from the table in Appendix 1 to a data window in KaleidaGraph. Make a graph presenting your data on linear coordinates: Wavelength should be plotted on the abscissa and percent on the ordinate. Plot four separate curves on the graph: one for red, one for yellow, one for green, and one for blue, as is shown in Figure 1 below. Create two new data columns from your data: red minus green and yellow minus blue. Use the Formula window to compute these values. Plot a second graph of your red-green data and your yellow-blue data, like Figure 2. Do these new curves resemble opponent processes? Fit a 9th order polynomial to the data using the Polynomial item under the Curve Fit menu of KaleidaGraph.

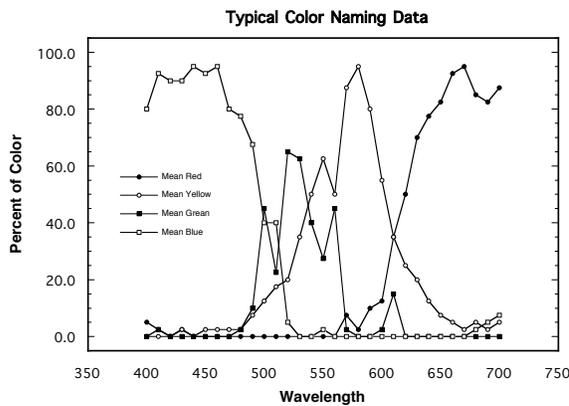


Figure 1

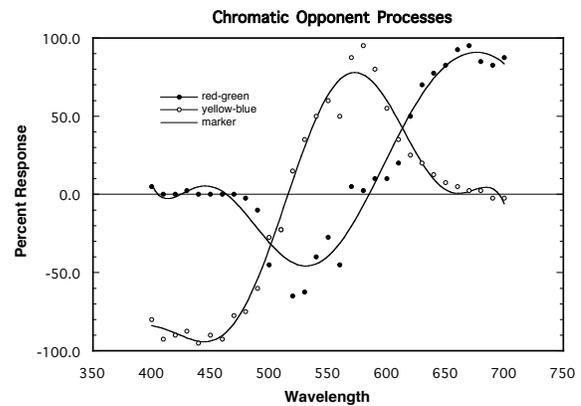


Figure 2

From your color curves in Figure 2, determine the wavelengths giving psychologically pure blue (where red and green are zero), green (where blue and yellow are zero), and yellow (where red and green are zero). How do these wavelengths compare with those measured directly? In your discussion relate your findings to the opponent-process theory of color vision.

Compare your data (graph) with those of your group members. How are they alike and how do they differ? If you have someone in your group who has a color deficiency examine his (most likely it would be a male) data carefully and compare them with the members of your group who have normal trichromatic color vision.

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Laboratory Report

Your lab report should contain five parts: *Cover Sheet*, *Introduction*, *Methods*, *Results*, and *Discussion*. In the *Introduction* explain why you did the experiment. In the *Methods* section describe what you did. In the *Results* section present your findings, including graphs of your data. In the *Discussion* of your results, here are some important questions to answer. Is there a systematic relationship between wavelength of light and the percentages of red, yellow, green, and blue experience evoked by it? Are there any points in the wavelength spectrum that give rise to a unique hue? A unique hue would occur at a wavelength that gave 100% of one color name and 0% of the other three. Look at the relationship among the four curves. Do pairs of curves seem to have a special relationship with one another? Relate your findings to the trichromatic theory of color vision proposed by Helmholtz and to the opponent-process theory proposed by Hering.

Your lab report should be brief and contain six sections: cover page, introduction, methods, results, discussion, and references. These sections should conform to the American Psychological Association (APA) style as described in Chapter 13 of the Martin book. The results section should contain the graphs plotting your data and the opponent-process transformation. The report is due at lab meeting (**2 or 4 November 2004**). Late labs will receive a grade of zero. All lab reports must be prepared with a word processor. It is worth 50 points.

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Appendix I: Data Tabulation

	Wavelength	Red	Yellow	Green	Blue	Total
1	400 nm					
2	410 nm					
3	420 nm					
4	430 nm					
5	440 nm					
6	450 nm					
7	460 nm					
8	470 nm					
9	480 nm					
10	490 nm					
11	500 nm					
12	510 nm					
13	520 nm					
14	530 nm					
15	540 nm					
16	550 nm					
17	560 nm					
18	570 nm					
19	580 nm					
20	590 nm					
21	600 nm					
22	610 nm					
23	620 nm					
24	630 nm					
25	640 nm					
26	650 nm					
27	660 nm					
28	670 nm					
29	680 nm					
30	690 nm					
31	700 nm					

Wavelength giving psychologically pure blue	
Wavelength giving psychologically pure green	
Wavelength giving psychologically pure yellow	