RGB Colour Palette Based on Hue Relationships

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ABSTRACT

A perceptual study of the RGB colour cube was conducted. In later stages of this research an RGB colour notation system based on perceptual RGB colour relationships was developed. A notation for an RGB colour wheel is proposed and colours are organized based on hue relationships. An application of this research was integrated as a graphical user interface (GUI) approach, which led to the development of an experimental colour swatch palette. The experimental palette is a departure from the traditional six-cut view of the RGB cube found in software such as Freehand and Flash.

1. INTRODUCTION

This paper briefly describes an experimental colour palette that was developed from the perspective of information design and aimed at proposing an alternative way to present RGB colours on the computer screen in order to facilitate the colour design process. First, a study of the perceptual structure of the RGB colour cube[1] was conducted. Subsequently, both an indexing notation system and a colour swatch palette accessing a predetermined set of RGB colours based on hue relationships were developed.

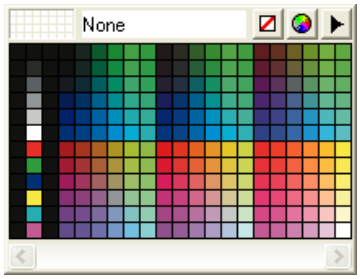

Figure 1: Swatch Palette of RGB colours based on six sections of the RGB colour cube.

The perceptual organization of colours in the RGB colour cube is based on mathematical principles from which colours on the computer screen are produced. In general, an RGB colour swatch approach can be used to show several available colours simultaneously. While an advantage is that one can see all the available RGB colours at the same time, a major disadvantage is that it can be particularly difficult to organize RGB colour swatches in ways that support effective colour selection processes based on colour design principles.

Because the RGB colour cube was not created to be used as a colour selection method on the computer screen, various ways to organize RGB colours to facilitate colour selection became commercially available. For example, a palette titled "VisiBone web-safe color wheel swatch"[2] is a visualization tool turned into a computer colour swatch that attempts to restructure the method of accessing RGB colours by "rendering apparent what was obscure, building tools to seed insight and enflame intuition." [2] This palette currently ships with Adobe Illustrator and Photoshop.

The experimental colour swatch palette here proposed is a departure from the traditional six-cut view of the RGB cube (See Figure 1), which is currently the default swatch palette in software such as Freehand and Flash. For this research the author proposes a method to organize the six-cut view of the RGB colour cube while taking into account the perceptual organization of RGB colours. This method is based on systematic RGB colour hue relationships.

Note: Please note that the colours in the jpg images in this paper are not accurate reproductions of the RGB values they represent.

2. NOTATION SYSTEM

According to Stromer, Ostwald proposed that "each pigment color can be characterized by specifying its color content (at a particular color hue) [such as red, green, blue, etc.], white content, and black content."[3] This approach allows each individual colour family (hue), whether it is pigment

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or computer colour, to be systematically compartmentalized. The first step in this research was to find a way to organize the colours presented in the traditional six-cut view of the RGB colour cube (See Figure 1) based on hue similarities. Simultaneously to this process, the author worked on the development of a notation system in which hue relationships of digital colours were strongly identified. For this purpose, Ostwald's work[4] served as inspiration. In later stages of this research, the notation was finalized.

The RGB colour wheel proposed (See Figure 2) is made up of three primary colours: Red (R), Blue (B), and Green (G). There are three secondary colours on the wheel that are produced when primary colours are mixed: Blue and Red mixed create Magenta (M); Red and Green create Yellow (Y); Green and Blue create Cyan (C). The transition steps in between the primary and secondary colours are what make up the tertiary colours and are named as follows: Red-Yellow, Green-Yellow, Green-Cyan, Blue-Cyan, Blue-Magenta, Red-Magenta. Each tertiary colour is divided into four sub-categories as seen in the colour wheel. For example, between Cyan and Green one will find Cg, CG, GC, Gc. The upper and lowercase letters are used to represent the level of perceptual predominance of either a primary or secondary colour. The capital letter indicates the predominant colour. When both letters are capital, the letter on the left takes precedence.

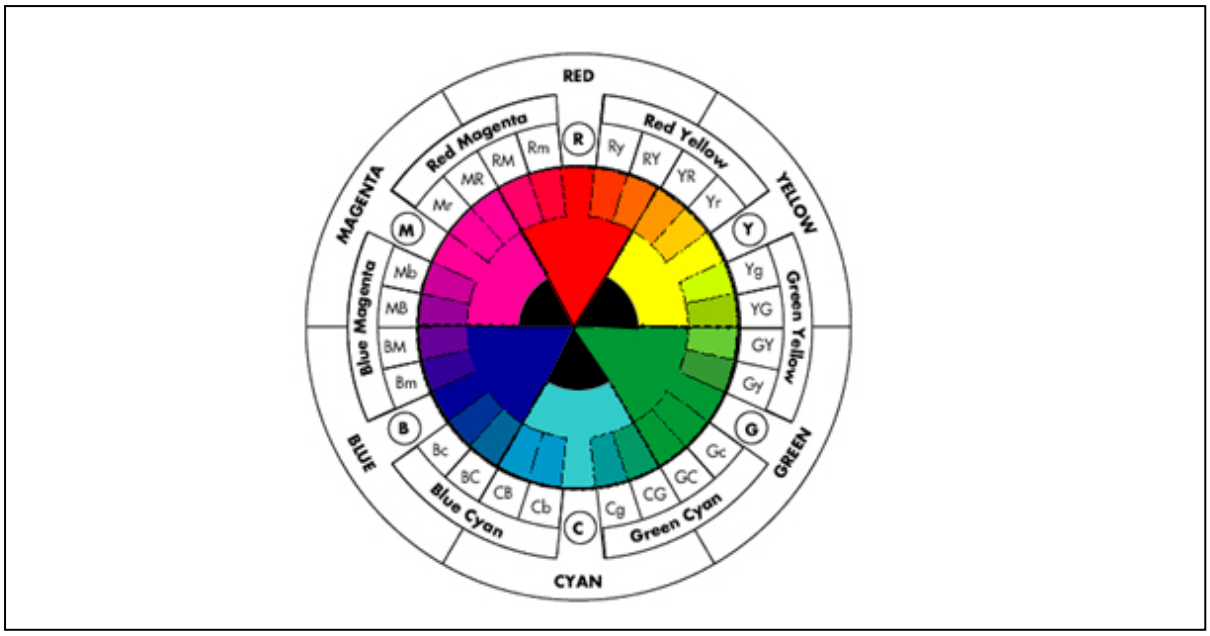

Figure 2: Bendito's RGB colour wheel notation.

What follows is a description of the notation structure. The primary and secondary colours are represented by the beginning letter of their name (See Figure 2): R = Red; B = Blue; G = Green; M = Magenta; C = Cyan; Y = Yellow. Tertiary colours are made from a combination of primary and secondary colours. The notation for the tertiary colour is the combination of the two beginning letters of the colours from which they are made. For example, Red (R) and Yellow (Y) produce the tertiary Red-Yellow.

Moreover, Red-Yellow is subdivided into five colour steps that are labeled Ry, RY, <u>RY</u>, YR, Yr (See Figure 3). The upper and lowercase letters are used to represent the level of perceptual predominance of either a primary or secondary colour. The capital letter indicates the predominant colour: Ry = Mostly red, a little yellow; RY = Almost even, more red; <u>RY</u> = Even amount of red and yellow; YR = Almost even, more yellow; and Yr = Mostly yellow, a little red.

Note that the RY colour does not appear in the RGB colour wheel. This is because the colours on the colour wheel are made of colours located on the outside of the cube. RY can only be found on the inside of the cube. Figure 4 provides a summary of the notation system that can be applied for each colour family and the neutrals. The RGB gray scale has 6 steps from black (K) to white (W). The intensity of a colour increases from left to right towards its pure state. Each colour can be mapped according to the family it belongs to (e.g., red, blue, etc.), its relation to the gray scale, and its level of intensity.

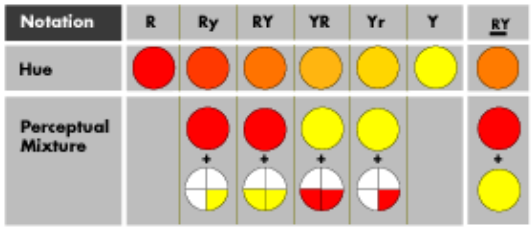

Figure 3: Explanation of notation from Red (R) to Yellow (Y) in Bendito's RGB color wheel.

For example, in Figure 4, the notation Y 8/4 means: Y = this colour is yellow (Y); 8 = this is the location of the colour in relation to the gray scale; and 4 = this is the level of intensity. In this case, the colour has low intensity. The same principles are applied to other colour families as can be seen in Figure 5.

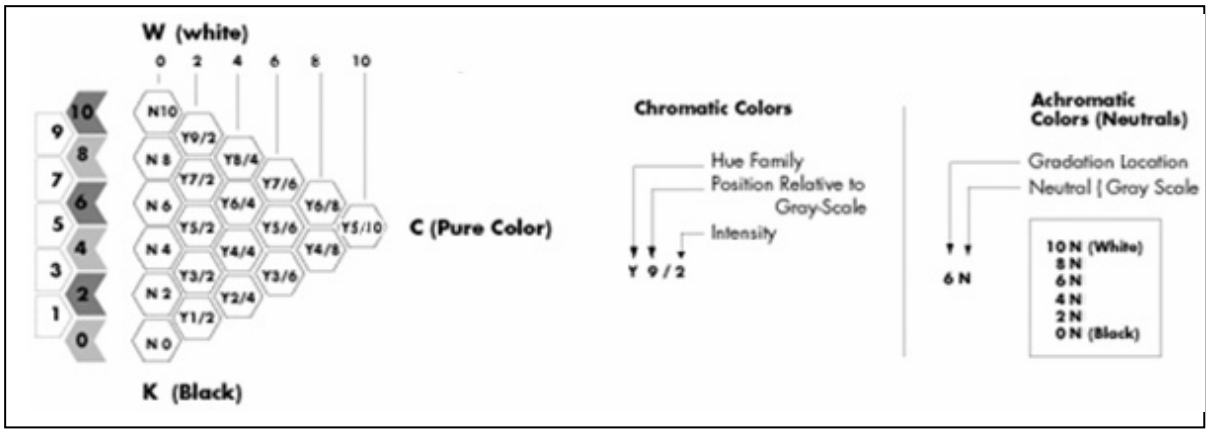

Figure 4: Bendito's notation system summary. Copyright © Petronio A. Bendito.

In Table 1, three RGB notation systems are compared. Note that the perceptual notation (PN) system has the potential to pinpoint the colour family, its "spatial" relation to the gray scale, and its level of purity (intensity), whereas the RGB-only and hexadecimal values are mathematically precise but lack perceptual clues.

Table 1: Notations comparison chart (no colour correction applied to this table)

Colour	PN	RGB	Hexadecimal
	Y 8/4	R=255; G = 255, B=153	FFFF99
	Y 5/10	R=255; G = 255, B=000	FFFF00

3. APPLICATION AND CONCLUSION

An application of this research was the development of a graphical user interface of an experimental colour swatch that displays RGB colours based on systematic hue relationships as previously described. The notation and consequently the experimental colour swatches here presented seek to create a logic perceptual map of a predetermined set of colours in order to facilitate the process of making colour selection for design purposes. Note that this notation does not claim an even colourimetric distribution. This is particularly evident in the colour Green and its derivative colour families (e.g., Yg, Gy).

Figure 5 shows six simultaneous views of the palette. Users navigate the palette by clicking on the left or right arrow. In future versions, they will also be able to use a slider. This experimental colour palette provides access to computer colours based on perceptual relationships. In informal observations the experimental colour palette has facilitated the process of colour selection during experimentation with design principles. A usability test and task analysis of prospective users utilizing the experimental colour palette has been conducted and is in the process of being analyzed. In addition, a qualitative research methodology will be employed to explore users' perceptions and outcomes of their experiences using the traditional and the experimental colour palettes.

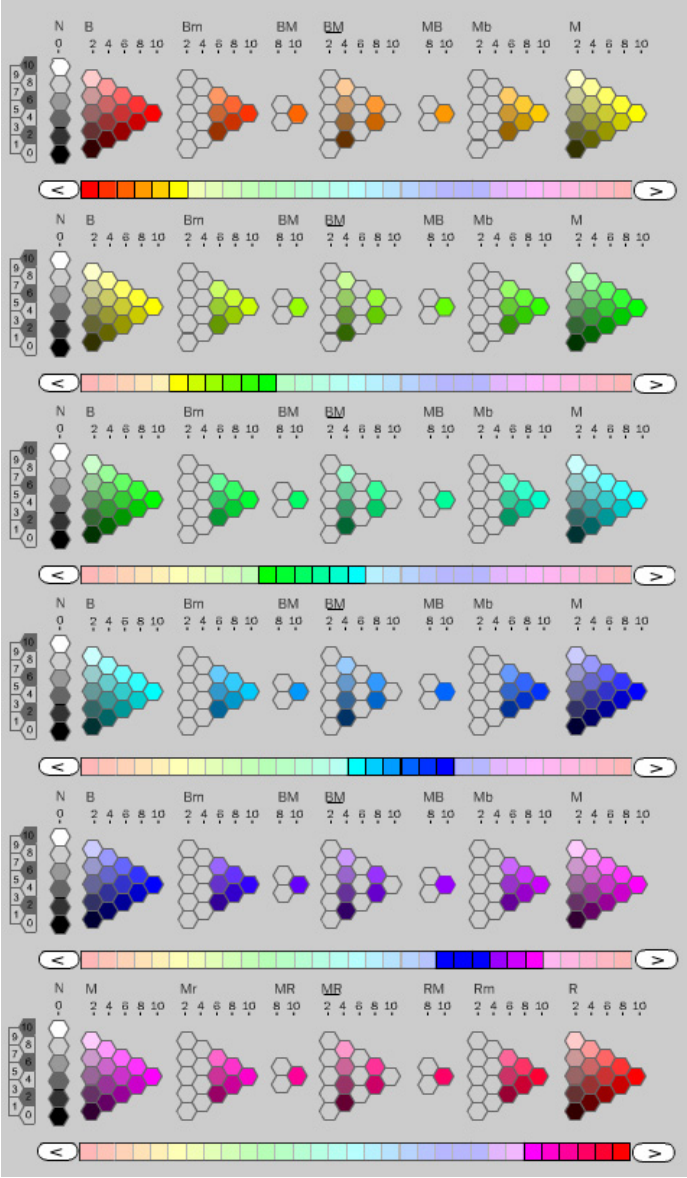

Figure 5: Colour palette interface method. 216 RGB colours organized based on hue relationships proposed in the notation system (Compare with Figure 1). Copyright © Petronio A. Bendito.

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