White is Green – New Schematic Diagrams

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ABSTRACT

Two new schematic diagrams are presented here that derive from the study of the value relationships of the primary colors of RGB computer and video color. The first diagram is a 'Truth Table" that presents true-false, on-off states of the three colors of RGB so that the colors are presented in the order of their brightness values. The second diagram is a triple Venn diagram based on the perception of color. This diagram is presented as an alternative to the Venn diagrams of additive and subtractive color usually used to explain color.

Keywords: Venn diagram, value relationship, truth table, difference algorithm, Goethe, Ockham

1. INTRODUCTION

The author's original goal was to describe digital color as bits turned on and off for red, green and blue.
What should have been a simple description of additive colors as having one bit on and subtractive colors as having 2 bits on was stymied by the lack of symmetry and reciprocity of the additive and subtractive models of color.

This in turn led the author to a long period of research into the value relationships of the primary colors of RGB color, resulting in the previously published papers on "White is Green"

2. DIGITAL COMBINATIONS OF RGB PRIMARIES

The following chart of RGB color is based on the values of RGB primaries.
The chart resolves the problem of the extreme brightness difference in RGB primaries. (Figure 1)

Bitmap	Green	Red	Blue	Hue	Sample	Grayscale	Brightness	
	1	1	1	White			100%	
	1	1	0	Yellow			89%	
	1	0	1	Cyan			70%	
	1	0	0	Green			59%	
								50%
	0	1	1	Magenta			41%	
	0	1	0	Red			30%	
	0	0	1	Blue			11%	
	0	0	0	Black			0%	

Figure 1: Chart of RGB Primaries in brightness order

There are eight possible combinations of three RGB primaries, indicated by a 1 for on and a 0 for off. The first bit is for green because green represents half of the brightness of white. There are four colors with the green bit on. They are white, yellow, cyan and green. With green off, the colors are magenta, red, blue and black. This corresponds to the way a white rectangle appears when viewed through a prism as described by Goethe. Cyan is within the white area and blue is within the black area. Yellow is within the white area, red is within the black area.

Digital information is represented by 1 for yes, on and true. 0 represents no, off, and false. Analog information, such as the brightness of a light source, must be divided into on or off at a threshold level. The threshold for a single bit of data to represent black or white is 50% brightness.

In the chart above, the 50% threshold falls between magenta and green when colors are ranked by brightness. Magenta and all the colors below it would register as black; Green and the colors above it would register as white when the colors are converted to a bitmap.

Red is the second bit in this chart because it is half as bright as green.

Blue is the least significant bit because it is less than half as bright as red. The color chart that results from this order of bits shows RGB colors in their order of brightness.

Red and blue combined are not brighter than green alone. It is important to make this asymmetrical relationship basic to the color model.

The brightness values in the table above were derived by:

- Creating a PICT file of color samples.
- Setting the monitor display to 256 gray
- Creating a screen capture file of the grayscale image
- Reopening the captured grayscale image in RGB color in Photoshop
- Measuring the brightness values in the HSB display in the INFO window.

A grayscale conversion algorithm was not used. Converting red, green and blue to grayscale using the grayscale algorithm in Photoshop yields brightness values that total more than 100%. Blue is especially effected and is converted to a much lighter gray than 11%.

A functioning model of color that can represent all of the 8 combinations of RGB can therefore be posited on the following conditions of true/false:

1 The presence or absence of brightness
2 The presence or absence of red
3 The presence or absence of blue

In this model green would be brightness=true, red =false, and blue=false.

Using the truth table above, ‘white is green’ can be argued with Ockham’s Razor: “Pluralitas non est ponenda sine necessitate.” Distinctions should not be made that are not necessaryGreen appears as white in the 50% threshold conversion to a bitmap It is not necessary to distinguish white from green with a single bit of data in a bitmap

Figure 2 is a picture of red ground, a green plant, and a blue sky that was created in RGB primaries. It was converted to a grayscale so that the combined brightness of the three colors equaled 100%. Figure 3 is the same image converted to a bitmap at 50% threshold. Only the green plant remains visible.

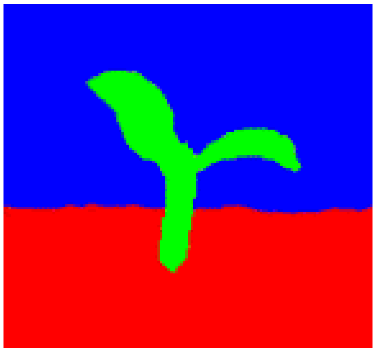

Figure 2: Green, red and blue

converted to gray values

Fig 3: converted to bitmap

Figure 3 shows that the logical condition of brightness=yes does not distinguish between white and green.

3. VENN DIAGRAM OF BRIGHTNESS/DIFFERENCE PERCEPTION

The Venn diagrams of additive and subtractive colors that are used to explain color are usually displayed side by side on a screen or printed page. There is an implied reciprocity to this juxtaposition that does not exist. On the printed page the green that is produced by subtracting cyan and yellow ink is much darker than the green of RGB. On the screen, green is much brighter than the green produced on paper by CMYK.

The author wishes to propose a third Venn diagram based on the perception of color. This is a model of vision based on a brightness signal and a test of the brightness signal for the presence or absence of red and blue. The Venn diagram below (figure 4) is a dynamic model of how such a system would work.

The reader is urged to see this model function by reproducing the diagram on a computer and actually creating the color green from white. This is done by generating the diagram in a computer graphics application that has layers and a difference calculation. Each circle of this dynamic triple Venn diagram is on a layer, and the layers are set to calculate the difference from the layer beneath. The background is black. The first layer is transparent with a white circle in the center. The next layer is transparent with a red circle and the top layer is transparent with a blue circle. When the circles are moved on top of each other to create an overlapping Venn diagram, the colors of cyan, green and yellow are generated within the white circle. Viewing the diagram in a static black and white form is less convincing than having the working diagram on a computer screen and moving the circles to see how the color is generated.

The same circle can display both red and its opposite, cyan, by representing the difference between red and the contents of the circle beneath. Red is off (0) in the black layer and red is on (1) in the red layer. The difference is 1, so the condition for the portion of the red circle that is over the black background is on (1) for red.

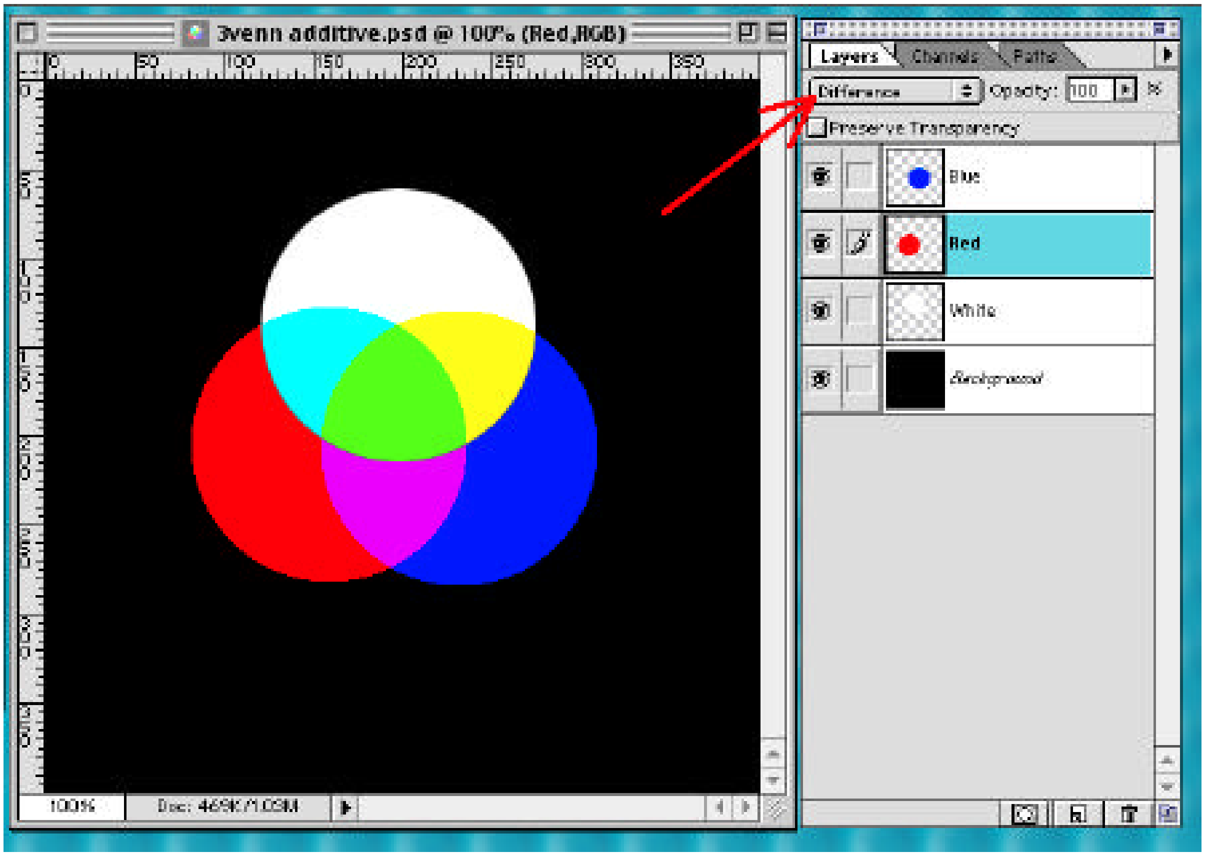

Figure 4: Venn diagram of difference calculations.

The difference between red and white is generated this way: G1 R1 B1 white layer G0 R1 B0 red layer G1 R0 B1 difference cyan	The overlap of red and blue circles and the black background generates magenta. G0 R0 B0 Black Background G0 R1 B0 red layer G0 R1 B0 difference also red G0 R0 B1 blue layer G0 R1 B1 difference magenta	The overlap of the white, red and blue circles generates green by this calculation: G1 R1 B1white layer G0 R1 B0 red layer G1 R0 B1 difference cyan G0 R0 B1 blue layer G1 R0 B0 difference green

4. CONCLUSION

These diagrams are offered as possible models of color. The author is not a color scientist and cannot speculate on ways that these diagrams could fit existing scientific theories of color perception. The diagrams are offered as a start for developing useful models of color that are based on the value differences of the primary colors of RGB.

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