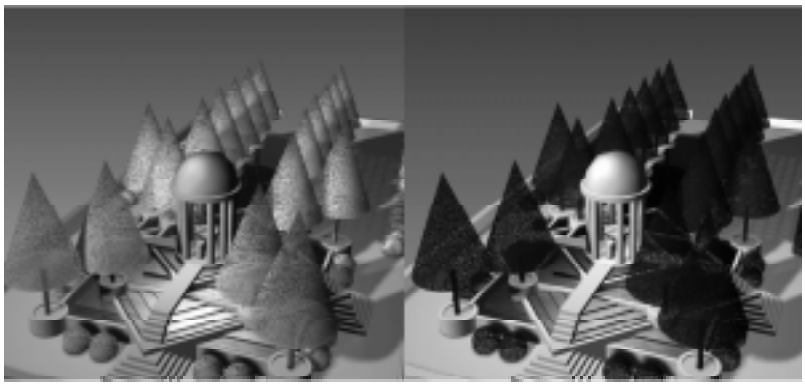
COLOR USE IN SOLID MODELING



Richard B Norman
Clemson University, Clemson SC, USA
rnorman@clemson.edu

Abstract
In computer modeling color selection usually determines the success of a visual message; color contrast is at the heart of graphic composition. Johannes Itten has said that there are but seven ways in which colors contrast. A course at Clemson University explores color in combination with architectural solid modeling; this paper is based on experiences from this class.

Well-composed color make's any drawing more understandable, delighting the eye and conveying the visual idea in a more meaningful way. Computers depend on color contrast to communicate their image; it behooves any graphic designer to understand how colors are assembled.

Antecedents

The history of color studies is long and devious; Isaac Newton first conceived of the color wheel, negating much of previous Greek tradition in the process, and laying a foundation for the principles of color as we understand them today. There followed many models in a progression that lead to the three dimensional concept of color used by today's computers. Based on red, green, and blue as primary colors, these colors are individually produced and assigned to each pixel on computer screens and on printers the world over.

For Johannes Itten, red, green and blue were not primary colors at all. Itten was part of the Bauhaus — that famous German institution that laid the roots of modern design in the difficult period between the two world wars. He believed that red, yellow and blue were the absolute primary colors; much of the famous Bauhaus color theory was developed by Itten and is based on this assumption. Itten taught the basic course in color theory at the Bauhaus. He adamantly believed in a three-dimensional color model with poles of black and and with a perimeter color wheel. His concepts of color hue, value, and saturation are based on this model and are still descriptive of color today. Among his writings is the unique revelation that we perceive everything only because of its contrasting color. In all the world of color he postulated that there are but seven unique ways in which color can be contrasted. In his own words, "Each is unique in character and artistic value, in visual, expressive and symbolic effect, and together they constitute the fundamental resource of color design".[1]

Objectives

Accepting his theory, we will verify the logic of his assumptions through a careful examination of color contrast applied to architectural solid modeling. If his is an absolute truth, then by understanding these contrasts we can make color selection far more objective than present practice dictates.

Methodology

At Clemson University in South Carolina, USA, color selection and graphic design are taught in a course in architectural solid modeling. Here students explore the modeling of architectural designs on the computer, but in doing so they must select colors for every material they place in a composition. By establishing color choices on the computer screen their work becomes understandable, perceivable. To a large extent the combination of colors that they choose determines the desirability of the design.

If theory can be added to the seeming randomness of this selection process, then direction is given. These contrasts, taken completely from Itten, are described below.

Contrast of Value
is the first, and most obvious of his seven contrasts. Thanks to black and white photography we are familiar with value contrast, we understand how every object has a value and see that the accumulation of these values on paper produces a recognizable image. For years students have been encouraged to begin a drawing by doing a charcoal sketch, determining first the anticipated value composition of their final product. Computers seem to mimic this process by selecting appropriate values automatically for any surface based on their angle to a light source. But this is only a mimicry, it produces a readable drawing but the computer does not compose. Examining first the "point of view", then exploring different light sources, students can select a value composition from a vast number of choices. Piranesi did not produce his miraculous drawings of Prisons without thought to establishing a value contrast that would bring in focus the essential elements of his composition; successful contrast of value makes any composition readable, it is at the heart of graphic story telling.
Students are made aware of value contrast in their computer compositions; yet this is no more than has been done in architectural schools since the renaissance. Contrast of value is an accepted graphic tool today, almost to the exclusion of the many exciting possibilities.

Contrast of Saturation
is more difficult to understand and to use than value difference. Yet it appears to be the secret of bringing depth into a composition. Traditional painting makes use of saturation contrast extensively, coloring those objects in the foreground with intense color while leaving objects in the rear in more neutral tints and shades. In the famous Ecole des Beaux-Arts of Paris, made good use was made of saturation contrast in rendering the elaborate facades that students composed. Frontal elements were richly rendered in watercolor, but as the composition receded the color became less saturated. In this way attention was focused on the foreground; a further background was only suggested with the weakest of watercolor washes, clearly demonstrating its relative importance. This of course is an exaggeration of what one would actually see, yet it is an essential bit of compositional "license". Computer drawings rarely understand this principle, for there is nothing automatic about creating this effect. The designer must be aware of the technique and cause it to happen through the use of contrasting saturation. Being made aware of this principle, students find their color composition improved; they often find themselves lead to a simplification of the drawing itself.

Contrast of Hue
makes use of that circuit of color known as a color wheel. It is defined as the way that red differs from green, or green from blue. When color schemes are accomplished in rudimentary art classes, students are usually taught the principles of hue selection, seeking a mathematical logic in the geometry of the wheel. But today that geometry is different from what Itten believed and different from what has been taught in many schools. Yes, red will always contrast with green, or yellow with blue, but the selection of hue seems more a matter of current taste than a display of artistic principle. Traditionally it has received much attention, primarily because by selecting the proper hue one is able to convey the emotional quality of the object; one is led into color psychology.

Students find the subject of color psychology of great interest. Why is the mood of "red" different from the mood of "blue"? Most of what has been written on this seems to be guesswork, though it is consistent guesswork — enough that there is a universal truth to what is said. Many texts can be found on both the psychology and the poesy of color.

These three contrasts, hue, value, and saturation can be considered primary for they have become a method of describing the color model. Thinking in terms of a three dimensional, x,y,z based model, each of these qualities describes one of its dimensions — together they potentially describe all of the world's colors. There are four more contrasts, each complex in idea yet unique in concept.

Complementary Contrast
is simply making use of the colors from opposite sides of the color wheel, yet complementary contrast is distinctly different from hue contrast. The effect is entirely different. There are two unique qualities in complementary colors: seen together they colors intensify each other, mixed together they become gray. Joseph Albers, in his experiments with after image proved this visually.[2] The pointillists, Saurat and his followers made extensive use of the contrast. They found that when colors were mixed traditionally they became dull. By painting with "points" of pure color on a canvas they would cause colors to stand alone, and so create a more vivid picture.

Architectural renderers find considerable logic in the selection of a complementary color. Students often to come to the point of choice, where a color must be selected because another object is needed. If it is a feature which should stand out in contrast, then the complement will surely do that; trouble only begins when a third color must be introduced.

Scale has much to do with selecting colors to cause a complementary contrast; a blue brick for example, to be included in a mix of brown toned bricks can gray a whole
wall if both scale and color are correctly chosen; when the colors blend into gray,

but neither color is appreciated for what it does to the composition.

Contrast of Temperature
is unique in the color world; temperature is not an absolute term. A bowl of tepid water may feel warm if compared with ice water, but cool if compared with a boiling caldron. There is neither absolute warm color nor totally cool color; colors are only “warmer” or “cooler”. But to a portion of any composition can be made to stand out when its colors are warm in a cool world or cool in a warm world. This is a point students seem able to quickly grasp, it is an excellent way to give weight to the center of attention in a composition.

Simultaneous Contrast
is defined as the demand of a color for its opposite. Itten says that it cannot be photographed, that it is a phenomena that exists only in the eye.[3] Yet this seems to be the secret of Van Gogh’s painting, for he is able to do things with the quality of light that are truly unique, most of his paintings stand out from their surroundings. We have discovered that they are based on the use of complements and that many of them contain neutral fields on which the eye can project an after image. Yet of all the contrasts that Itten proposes, for a student, this is the most impossible to duplicate as a principle of color composition.

Contrast by Extension
is the contrast of much and little, of big and small; it can be useful to the graphic designer. If there is a ceiling of tiny stars in a space, such as the ceiling of Grand Central Station in New York City, those stars can appear bright, they stand out compositionally — not because they are brighter, but because they are smaller. This seems as simple as it is obvious.

Results & Conclusions
Johannes Itten proposed only seven color contrasts and I have been unable to find further ways in which color can be contrasted. The list is his, but carefully used, it gives definition to the selection of color. Each of these contrasts can form the foundation of a good color composition.

Well-composed color make’s a drawing more understandable, delighting the eye and conveying the visual idea in a more meaningful way. Computers depend on color contrasts to communicate their image. As students become more aware of the effects of successful color composition, their drawings are made more readable, more visually exciting, and more communicative of their graphic intent. We have found that through the use of these principles, computer graphics become more readable, more visually exciting and more communicative of their graphic intent.

Bibliography

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[1] Itten, 1973, 36

[2] Itten, 1973, 78

[3] Itten, 1973, 87