The Modular Color Palette:
Systems of Color Selection in the Paintings of James Mai

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Abstract

Limited color palettes have been employed by artists for centuries, but most have lacked a rigorous organization sufficient to permit color relationships to compete in clarity and complexity with compositional relationships. Artist James Mai proposes new, systematic methods for color selection in his *modular color palettes*, limited palettes whose colors conform to discrete positions within the range of color variables. These modulated colors are used to create general *palette-types*, each of which can yield multiple *palette-versions*. Modular color palettes are built from precise modulations of the intrinsic dimensions of color—hue, value, and intensity—and offer new possibilities for color-motivated painting. In this paper, the author elucidates the dimensional structure of color, explains the development of his palette-types and palette-versions, and examines how modular color palettes are employed in a selection of his paintings.

Introduction

For the artist, a *limited color palette* is a deliberately restricted set of colors which, by some principle of selection, has been drawn from a wider variety of colors. The criteria for selecting limited color palettes can vary widely, but usually they are organized by some intrinsic, optical characteristic of color itself (e.g., a "warm palette," a "high-key palette," a "complementary palette"). In practice, however, most limited palettes are merely a narrowed selection of mixing pigments, which in the course of painting may be mixed in any combination, proportion, or quantity desired—the limited palette in many cases becomes virtually unlimited. This not only contradicts its defining characteristic, but it undercuts the potential for selective color relationships to be seen and understood as a primary aesthetic purpose in the work of art.

I have worked towards a more thoroughgoing systemization of limited color palettes for use in my paintings. These *modular color palettes* are characterized by: (1) a finite set of pre-mixed colors, usually totaling between four and twelve, employed in the artwork without further additions or alterations; (2) colors that are deliberately modulated in hue, intensity, and value, so that each occupies a unique, identifiable position in all three color-dimensions; (3) colors that are "tuned" to each other so as to establish precise similarities and contrasts in one or more color-dimensions. To best understand the following explication of modulated color palettes, it will be useful to examine the fundamental structure of color and to establish the terminology that will be employed throughout this paper.

A Color Primer

For the purposes of this paper, the triad of terms, *hue*, *intensity,* and *value* will be employed instead of the equally-valid, corresponding triad, *hue*, *saturation*, and *brightness*, typically employed in photography

and printing. These three qualities will be referred to as *color-dimensions*, where each may be identified, measured, and controlled independently of each other. However, they are isolatable in conception only, for every instance of perceived color includes simultaneously all three dimensions in some measure. For purposes of this paper, I shall employ the term *color* to mean the singular, collective instance of a particular hue-intensity-value; if one or more of these is changed by a discernible degree, then a different *color* is experienced. The traditional painter's primary and secondary hue-names, *yellow, red*, *blue* and *orange*, *green*, *violet* will be employed instead of the corresponding contemporary terms, *yellow, magenta, cyan* and *red*, *green*, *blue*. (The latter set also denotes somewhat different wavelengths than the former set. Although many artists continue to employ the former set, the latter hues are more fully in accord with the sciences of perception and light. For expanded explanations of these, see [1], [3], [5].)

Color is composed of three distinct visual qualities: hue, intensity, and value. *Hue* corresponds to different wavelengths of visible light, that quality which distinguishes both obvious color differences (e.g., redness from yellowness from blueness, etc.) and subtle differences between very similar colors (e.g., "tomato red" and "cherry red"). *Intensity* is that quality which distinguishes brighter, purer color from muted, greyer color (e.g., "lemon yellow" from "beige"). *Value* is that visual quality which distinguishes lighter color from darker color (e.g., "robin's egg blue" from "royal blue").

Hue is usually modeled in color theory as a circle of continuously changing, rainbow-bright colors. Although this is a fabrication, formed by "bending" the linear spectrum back upon itself and misleadingly joining its red and violet ends into a closed loop, the circle does provide a convenient model for showing the relationship between hue and intensity by placing complementary hues diametrically opposite on the circle. Changes in hue occur around the circle, while changes in intensity occur across/within the circle. For the painter, hue is best understood not merely as a continuum of changing wavelengths, but as a hierarchy of *primary*, *secondary*, and *tertiary* levels. The primary hues of subtractive mixing, yellow, red, and blue, are defined in theory as primary because: (1) they are un-mixable from any other hues, (2) they yield all other hues by intermixture, and (3) they form a complementary triad, meaning that a mixture of equal quantities of each results in fully neutral color. The secondary hues, green, orange, and violet, are each mixed from equal amounts of two primaries. Tertiary hues result from mixtures of a primary and an adjacent (i.e., non-complementary) secondary hue; these are yellow-green, yellow-orange, red-orange, red-violet, blue-violet, and blue-green. When adjacently placed in a continuous sequence, with secondaries residing between primaries, and tertiaries residing between primaries and secondaries, we have the familiar color-circle.
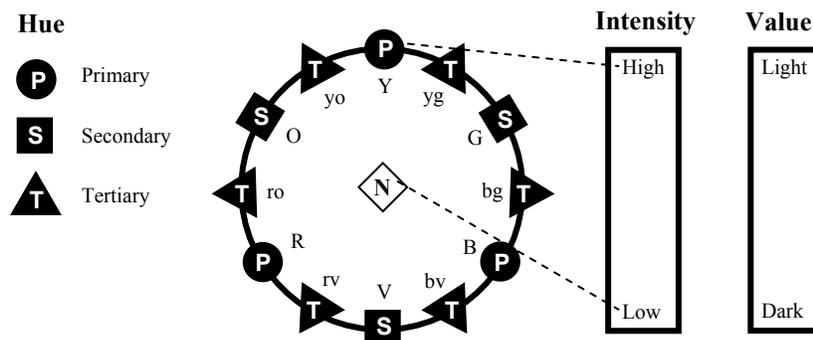
Figure 1: *The color-dimensions: hue, intensity, and value.*

Intensity is modeled linearly, with extreme high and low limits and potentially infinite gradations between. *High-intensity* color is pure and bright, as we might see in the colors of the rainbow or in the circumference of the color-circle. Intermediate intensities are duller by degrees and ultimately reach a state of *low-intensity*, also called *neutral*, where greyness denies the identification of any residual hue. High intensity is maintained around the perimeter of the circle by adjacent hue mixtures, while intensity is

lowered to varying degrees along any mixing path within the circle; that is, by non-adjacent hue mixtures. The most direct path to lowering the intensity of a hue is to mix it with its diametrically opposite hue, its *complement* (e.g., red and green, blue and orange, yellow and violet). Varying degrees of intensity are achieved by mixing a given hue with varying proportions of its complement. Fully neutral color ("pure grey") resides at the center of the circle, where all diametrical lines of complementary hues intersect. Value is also modeled linearly, with extremes of *light* and *dark* and potentially infinite gradations between. Value is varied in subtractive mixing by the addition of white (to lighten) and black (to darken). Value cannot be clearly understood in relation to hue and intensity by a two-dimensional color-circle, so various three-dimensional forms have been put forth as models for color, neatly marrying the three color-dimensions to the three dimensions of space (see [4], [5] for various three-dimensional models).

Finally, the terms *modular color* or *modulated color* shall refer to discretely-stepped, graduated scales of hue, intensity, and value differences, each step perceptually judged to be an equal increment of change. These scales may vary in both the selection of extremes and the number of divisions between the extremes, but the increments are always perceptually equal within the given scale-range. By dividing the continua of hue, value, and intensity into discrete, perceptually equal steps (much like the discrete notes in music), colors may be combined in highly controllable contrasts and equivalencies. These color modulations are at the foundation of the color palettes discussed below.

Modular Color Palettes: Palette-Types and Palette-Versions

I design limited color palettes on two levels: first, at the general level, by creating a *palette-type*, which is a set of instructions for modulating and selecting among the color-dimensions of hue, value, and intensity; second, at the specific level, by creating *palette-versions*, which are the various particular color sets that can be produced by performing different hue substitutions and color-dimension combinations within a given palette type. Thus, the palette-type is a set of instructions for combining color dimensions; the palette-version is one of a finite set of fulfillments of the palette-type instructions.

For example, a simple palette-type might call for the following set of five colors: Colors 1 and 2 are any pair of complementary primary and secondary hues at high intensity. Color 3 is a low intensity/neutral between Colors 1 and 2. Colors 4 and 5 are middle-intensity versions of the primary and secondary, visually equidistant between Colors 1 and 3, and between Colors 2 and 3. In addition, the following rule of value is applied: the sequence of five intensities (high, middle, low, middle, high) is constrained to a sequence of five equally-stepped values from dark to light, where the high-intensity colors are dark-value and light-value. This somewhat terse verbal description is diagrammed in Figure 2.

Two Inverse Mappings of Hue-
Intensity Sequence and Value Sequence
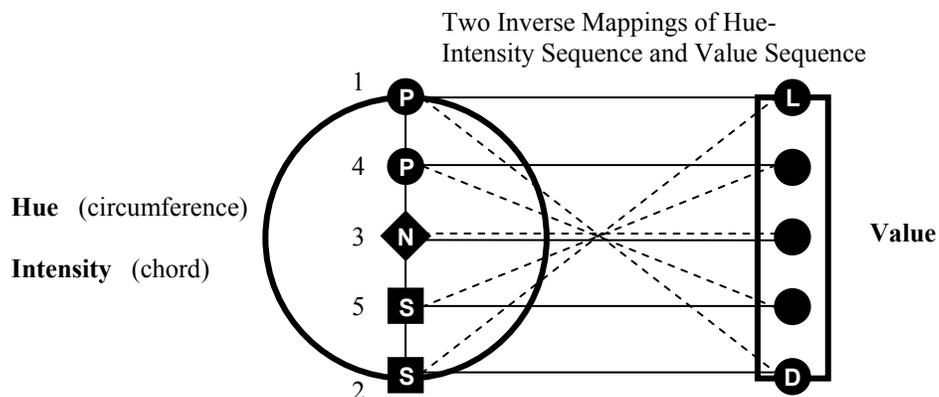
Figure 2: *Diagram of hue, intensity, and value relationships in sample Modular Palette-Type.*

From this single palette-type, six palette-versions are possible as a consequence of different substitutions of hues and re-orientations of the value sequence: three different hue-pairs may be inserted in the primary and complementary secondary hue positions (yellow and violet, red and green, blue and orange), and two different value sequences (reversals of each other) are possible for each hue-pair (light yellow to dark violet, light violet to dark yellow, light red to dark green, light green to dark red, light blue to dark orange, and light orange to dark blue). The intensity sequence is fixed in regard to values and hues (high intensity is always light and dark, middle-intensity is always middle-light and middle-dark, and low intensity/neutral is always middle-value). When mixed from pigments and seen side-by-side, the six palette-versions are quite different in appearance from each other; yet structurally, each possesses exactly the same ranges, modulations, and relationships of values, hues, and intensities. All six palette-versions are diagrammed in Figure 3.
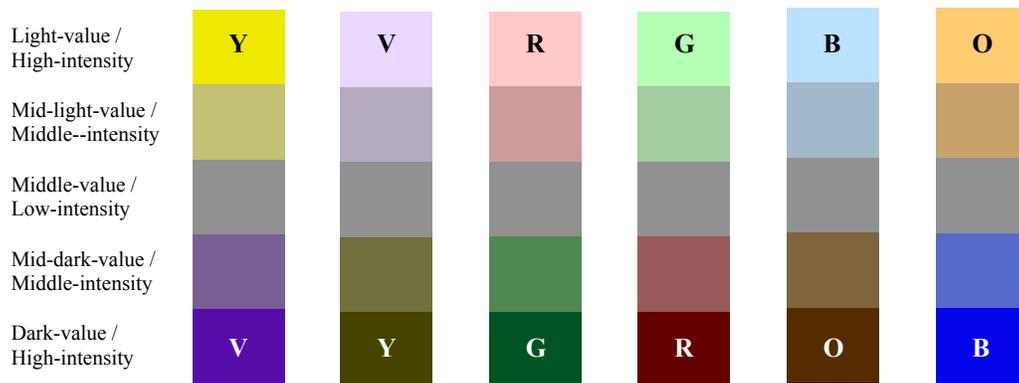
Figure 3: *Diagram of the Palette-Versions of Figure 2.*

This very limited palette may be seen to imply the full range of each color-dimension, since the extremes of value and intensity are represented (light- and dark-values, high- and low-intensities), as is the full range of hue (insofar as the difference between two hues cannot be greater than complementarity). These intrinsic palette attributes both constrain and open up the possibilities for how the color can function in a composition. For example, since each color is a distinct value, each shape in a composition will be distinguishable as lighter or darker than its neighbors. Subtle color contrasts can be made either by placing the two middle-intensities together or by placing a middle-intensity and the low-intensity together. Vibrant color contrasts can be made either by placing the two high-intensity colors next to each other or by placing a high-intensity color next to the low-intensity. All of these relationships, and more, can be further refined by varying the size, location, and number of areas each color occupies in a composition. In short, the modulated color structure calls for an appropriate compositional structure; this hints at new possibilities for color-motivated paintings, where antecedent color relationships determine subsequent compositional relationships.

We can see that many different palette-types may be generated simply by varying the rules for modulating, selecting, and combining the color-dimensions. Further, we can anticipate that different palette-types will yield different numbers of palette-versions, depending upon the number of substitutions and re-combinations possible within a given palette-type. For example, in the palette-type discussed above, changing one variable will double the number of palette-versions: If the rule for hue selection is revised to call for one primary and one *non-complementary* secondary hue, then the number of eligible hue-pairs becomes six instead of three; factored by the two 5-value sequences, there result twelve possible palette-versions.

From Theory To Practice: Modular Color Palettes and Compositions

Modular color palettes are designed to fulfill one of two primary purposes in my paintings: (1) to clarify compositional relationships of shape, size, position, and proportion (in these cases, color plays a supporting role to an overriding compositional intention); or (2) to generate simultaneous color contrast illusions, a perceptual illusion whereby colors change their appearances when seen in different combinations and contexts (see [2] for more information). While my modular color palettes and my investigations of simultaneous color contrast are inextricably linked, an examination of the latter is beyond the scope of this paper. The remainder of this paper will examine 3 modular color palettes and how they are employed in my paintings.

A modular color palette of the kind that clarifies compositional relationships may be seen in the painting, *Polar Scrolls* (Figure 5). The composition demonstrates, in four square partitions, ascending and descending sequences of consecutive integers beginning and ending with 1, expressed as areas arranged in square spirals. From left to right, the four sequences are: 1,2,1; 1,2,3,2,1; 1,2,3,4,3,2,1; and 1,2,3,4,5,4,3,2,1 (these are referred to as Sequences A, B, C, D, respectively, in the diagrams of Figure 4). The challenge for the color palette was to (1) make each of the areas within a sequence distinguishable, and (2) to make each of the four sequences distinguishable from each other. The palette was organized so that each compositional sequence of areas was married to an intensity sequence: high-intensity primary to neutral to high-intensity secondary. The four sequences were differentiated from each other by value, each longer sequence becoming progressively lighter. This means not only that each area within a given sequence is held to a constant value, but also that each compositional sequence employs a different number of intermediate intensities, and therefore a different palette-type. The palette-type diagrams in Figure 4 indicate the hue-intensity modulations (the circle) and the single value position within the value-scale (the rectangle) for each of the sequences. The palette-version employed in *Polar Scrolls* uses blue and orange for the complementary hues, but it might also have employed red and green, or yellow and violet (indeed, these versions have been used in other paintings). For purposes of black and white reproduction, values have been altered in Figure 5 to make compositional areas more discernable.
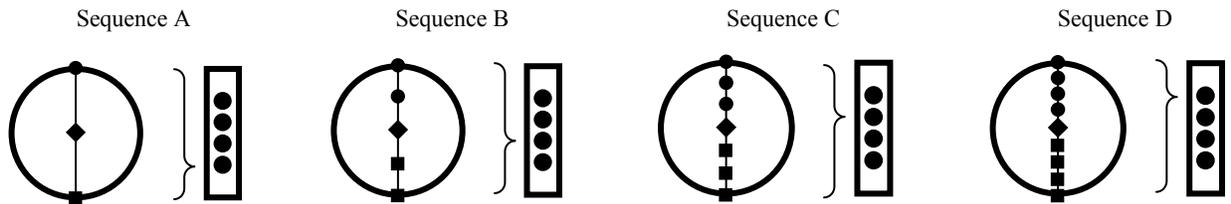
Figure 4: *Diagrams of the four Palette-Types used in "Polar Scrolls."*
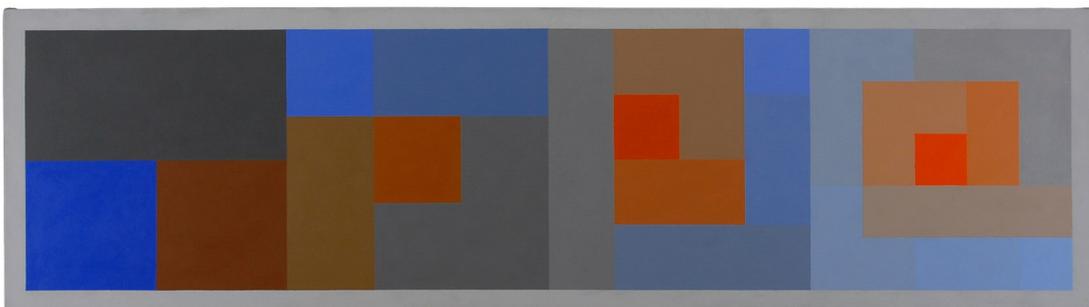
Figure 5: *"Polar Scrolls," acrylic on canvas 12 x 42."*

While the previous example shows four different palette-types at work in a single painting, I more commonly employ a single palette-type across a group of paintings, using a different palette-version for each painting in the series. This is the case with a group of six paintings titled *Contending*, three of which are reproduced in Figure 7. These six paintings employ a quite minimal palette-type of only four colors, diagrammed in Figure 6. All four colors in each of the six paintings are a single primary or secondary hue, modulated to four different intensities (a broad range, from high to nearly neutral), and modulated to four different but closely related values. The value range is very narrow and is localized within the full value scale in accord with the hue's *natural value*; that is, the inherent value of the given hue at its highest intensity (e.g., at their highest intensities, violet is naturally darker than yellow). Regardless of location within the larger light-to-dark value scale, the 4-intensity sequence corresponds to the 4-value sequence such that the high-intensity is the lightest value, the middle-high-intensity is the middle-light-value, the middle-low-intensity is the middle-dark-value, and the low-intensity is the darkest value.
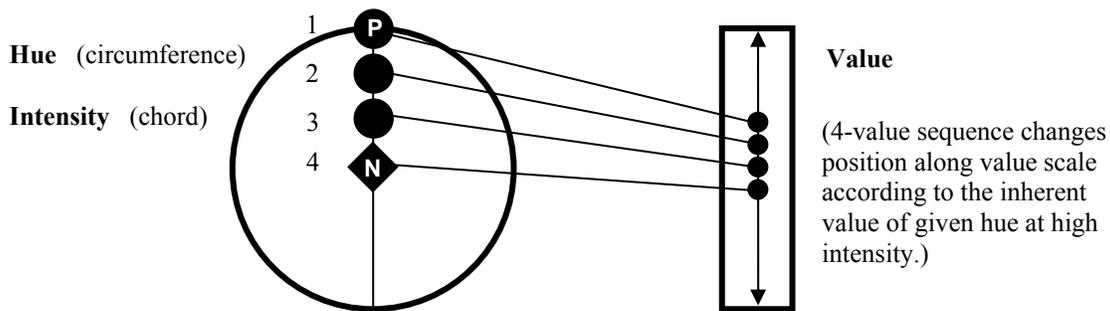
Figure 6: *Palette-Type employed in Figure 7.*
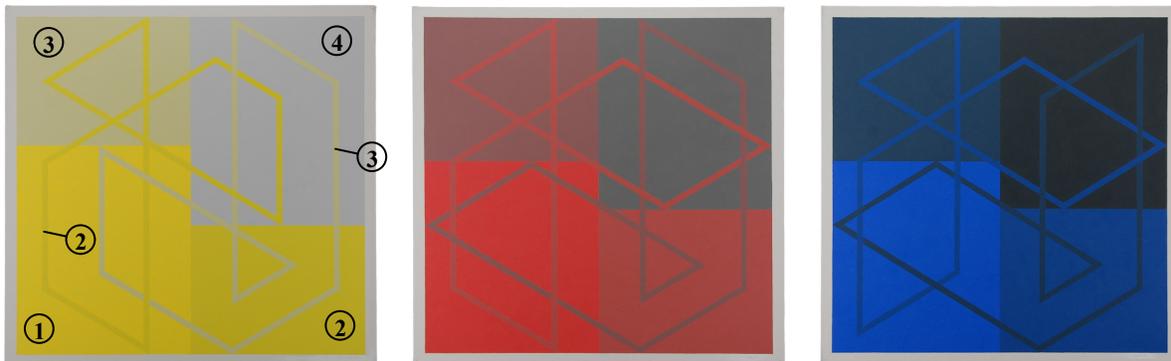
Figure 7: *"Contending (Yellow, Red, Blue)," acrylic on canvas, 32 x 32" each.*

This minimal palette is distributed in a composition that maximizes certain combinations of color-contacts. The two intermediate intensities, located in the upper left and lower right rectangles of each painting, are also the colors of the two lines that wind around the composition; these lines come into contact with the three other colors. More succinctly, given Colors 1, 2, 3, and 4, Color 2 contacts 1, 3, and 4, and Color 3 contacts 1, 2, and 4. (Colors 1 and 4 are not intended to maximize their contacts, since they are the extremes in this simultaneous color contrast composition.) The series of 6 paintings exhausts the primary and the secondary (not illustrated here) hue-versions of this palette-type; it would, of course, also be possible to extend the versions to tertiary hues. While each of the six compositions is different from the others in the specific shapes formed by the circuitous lines, they are identical to each other in the aforementioned combinations of contacts among Colors 1, 2, 3, and 4. So the six paintings are linked as a family not only by a common palette-type, but also by what might be called a common *composition-type*.

Another group of six paintings, titled *Circuitous* (Figure 9), employs the following palette-type (Figure 8) consisting of five colors: Color 1 is any tertiary hue at middle-high-intensity and at its natural value; this color serves as the reference hue for the other four colors. Colors 2 and 3 are the primary and the secondary hue components of Color 1; one of these colors is made lighter and the other darker than Color 1. Color 4 is a lighter value and higher intensity version of Color 1. Color 5 is a darker value and low-intensity (neutral) version of Color 1. As in the previously-discussed palette-type for *Contending*, the location of the 3-value sequence here shifts according to the inherent value of the given tertiary hue. This results, for example, in the range of values for the red-violet palette-version being significantly darker than the range of values for the yellow-orange palette-version, owing to the naturally darker value of pure red-violet compared to pure yellow-orange.

Hue (circumference)

Intensity (chord)

Value

(3-value sequence changes position along value scale according to the inherent value of tertiary hue at high intensity.)
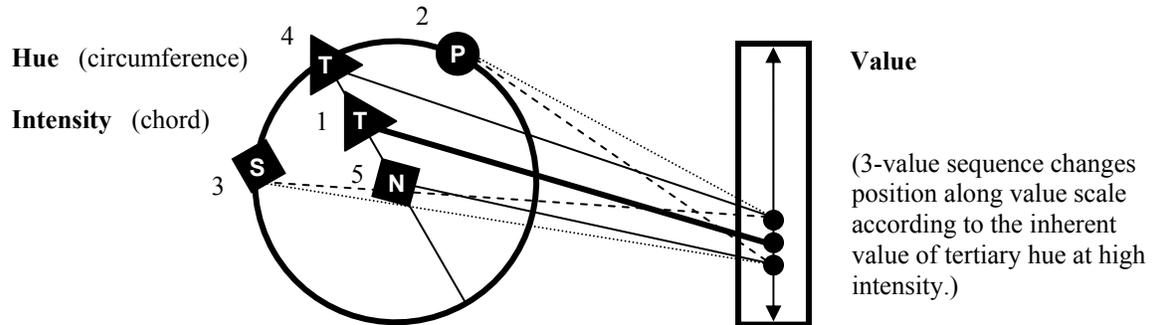
Figure 8: *Palette-Type employed in series of paintings, "Circuitous."*

Figure 9: *"Circuitous (RO, YG, YO, BV, BG, RV)," acrylic on board, 24 x 24" each.*

As in the previous example, these six paintings display a consistent compositional distribution of the palette colors: Color 1, the base tertiary hue, occupies the circuitous line. Colors 2 and 3, the primary and secondary component hues of the base tertiary, occupy the largest and smallest background areas, upper left and lower right. Colors 4 and 5, the high- and low-intensity versions of the base tertiary, occupy the two intermediate background areas. At their natural values, the primary and secondary hues will shift value positions according to palette-version (e.g., red is the lighter value in the red-violet palette, while it is the darker value in the red-orange palette). The basis for consistency in compositional distribution is value rather than hue: Beginning with the largest background area at upper left and proceeding down to the smallest area lower right, I maintain an alternating arrangement of dark-light-dark-light—the darker color in the largest area is in some cases a secondary hue and in others a primary.

Conclusion

Modular palettes offer to color what geometry offers to composition—commensurability.[*] In my work, the measure of color is essential to color's ability to function with an importance equal to composition. While the specific goal of modular palettes is to lend coherence and precision to the color relationships in any given painting, the broader goal of such work is that color should reveal its inherent, manifold, and fundamentally unique visual qualities as a primary content in art. This requires that compositional structures be in accord with color functions, permitting colors that should be seen together or isolated from each other to be so organized by shapes in the composition. This interdependence between color structures and composition structures has been a fundamental pursuit in my paintings for over 20 years.

It is important to understand modular palettes as aesthetically-driven color relations, and not as practical instructions for mixing paints or formulas for achieving "good color" in art. Nothing in the palette-types or even the palette-versions explains how to mix pigments, and no modular palette yields inherently better colors than another. "Aesthetically-driven" means here the creation of structured color relationships that play a substantial part in the final compositional, illusional, and/or metaphoric purposes of the work of art. Such a primary role for color calls for creative control in both the initial design and the subsequent perception of color relationships, and modular palettes can provide that creative control. But modular color palettes should be understood as strategies rather than rules for achieving those ends; the particular color relations in the palette-types and the specific colors used in the palette-versions are largely open-ended, intended to provide new choices and stimulate new creative possibilities for artists.

References

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[4] Narciso Silvestrini and Ernst Peter Fischer, *Color Systems In Art and Science*, Regenbogen Verlag Klaus Stromer, Konstanz, Germany, 1996. ISBN 3858627534
[5] Moritz Zwimpfer, *Color: Light, Sight, Sense*, trans. Dr. Edward Force, English Edition, Schiffer Publishing, West Chester, Pennsylvania, 1988. ISBN 0887401392

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[*] Much of the basis of my approach to color derives from the work of Prof. Victor Flach of the University of Wyoming; his "Differentially Integral Four-Color Palette" has provided a model for my own work in color palettes.