# The Aesthetiscope: Visualizing Aesthetic Readings of Text in Color Space

**Hugo Liu and Pattie Maes**

MIT Media Laboratory
20 Ames Street, Room 320D
Cambridge, MA, 02139, USA
{hugo, pattie}@media.mit.edu

**Abstract**

The traditional story understanding dogma in AI holds that there exists a singular, objective meaning implied by text, which can be uncovered by applying just the right logical inferences. But according to research into the cognition of reading, text can also be read, not objectively, but aesthetically. An *aesthetic reading* of text engages not only the agency of thought, but also intuition, sensation, and sentiment, and cultural interpretation. We have developed and implemented a basic computational model of aesthetic reading, which employs Carl Jung's Modes of Interpretation idea to delegate the task of aesthetic interpretation out to several different textual analysis engines, each computing a different *mode* of interpreting text, such as generating sentimental evocations of a text (Feeling modality), or remembering visual imagery evoked by the text (Sensation modality). The outputs of the various interpretive modalities are merged and then their unification is achieved by mapping them into color space using theories of color psychology. We built the Aesthetiscope, an artwork whose grid of colors are dynamically generated from aesthetic readings of an inputted poem or song, to illustrate the power and potential of going beyond literal understandings of text.

## On Aesthetic Reading

Much of the AI narrative understanding literature subscribes to the dogma that there exists a single rational method of interpreting text, and that resultant interpretations and inferences can always be reconciled into a single consistent world model. One branch of research notably departing from this dogma is concerned with *creative reading* (Moorman & Ram, 1994). According to the cognitively motivated theory of creative reading, textual understanding involves imagination, the suspension of disbelief, and the projection of inexact memories onto read situations; in contrast, the dogma says that textual understanding should be algorithmized simply as the rote invocation of inference rules. Moorman & Ram's revolt against the grain of the classical AI narrative understanding literature emboldens us in our task of *aesthetic reading*, which is the topic of this paper.



Aesthetic reading is not reading purely for information. It is an emotionalized and personal reading, whereby the text's primary purpose is to evoke aesthetic rumblings within the reader. Reading theorist Louise Rosenblatt states, "In aesthetic reading, the reader's attention is centered directly on what he is living through during his relationship with that particular text" (Rosenblatt, 1978, p. 25); but this notion of "living through" can be quite a complex amalgamate of perceptions and sensations.

In this work, we sought to develop a computational model of aesthetic reading that could be sophisticated enough to account for the diversity of the ingredients constituting the complex reader-to-text aesthetic relationship, while maintaining computational simplicity. Thus we developed our model around the inspiration of Carl Jung's Modes of Interpretation (1921), a psychological theory that he put forth to account for the different possible ways that people interpret the world. According to the theory, there are four fundamental modes of interpreting reality: Thinking, Feeling, Sensation, and Intuition. To these four modes, we added a not-so-fundamental fifth, Culturalizing, which incorporates Roland Barthes' thesis (1964) that people also interpret the world through the optics of our culture's values system. Also, for practical considerations, our work means the Sensation mode to refer solely to the remembrance of visual images.

Whereas *objective reading* relies primarily on the Thinking mode; aesthetic reading invites a reader to employ many, or all, of the Modes of Interpretation to engage with the text, each mode producing some evocations; and we can think of the sum of all produced evocations as the *aesthetic interpretation* of the text.

Based on this simple premise, we developed the following computational model of aesthetic reading: The *aesthetic interpretation* of a text can be computed by the application of all five Modes of Interpretation to a text. Each mode has its own logic for operation, but given some input text, each is able to output a set of *aesthetic evocations*, which in our work, is either a set of keywords, or a palette of colors. Ultimately though, even these keywords are translated into color space using some psycho-physiological heuristics which we have developed (more on this later). By combining the weighted outputs of the five Modes of Interpretation into a final palette, an

abstract color mosaic is generated, and we say that this is a visualization of the aesthetic reading of the input text; we call this AI-based artwork the Aesthetiscope, as it is able to visualize aesthetic readings of various text like song lyrics and poems within the psychologically and emotionally evocative universe of colors.

The rest of this paper is structured as follows. First, we present an overview of the Aesthetiscope as an art installation and explain its design rationale. Second, we discuss the technical mechanisms for computing *aesthetic readings* of text. Third, we reveal the mechanism for mapping the *aesthetic evocations* outputted by each Mode of Interpretation into color space. We conclude by discussing some redesigns we have made to the Aesthetiscope and reflecting upon the collected experiences of those who have interacted with the installation.

## Aesthetiscope as Art Installation

The Aesthetiscope is an interactive art installation whose grid of colors visualizes the *aesthetic character* of some text (a word, a poem, a song); moreover, by adjusting the contribution of each of the five Modes of Interpretation to the gestalt, the visualization can better suit the individualized taste of the perceiver. Figure 1 shows the

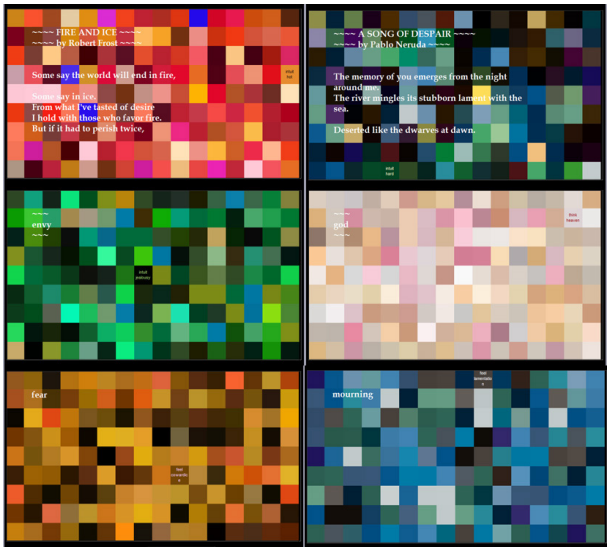


**Figure 1**: The Aesthetiscope, biased toward the Feeling and Intuition modes, renders the above portraits of (clockwise from upper left) "Fire and Ice" by Robert Frost, "A Song of Despair" by Pablo Neruda, and the words "God," "mourning," "fear," and "envy."

Aesthetiscope's visualization of the aesthetic of six different texts, from the point-of-view of a perceiver who has biased the aesthetic interpretation toward the Intuition and Feeling modes. In the remainder of this section, some explanation is offered for the major design decisions of the artwork.

### Reifying the Aesthetic in Color Space

The colors that constitute each color grid represent the combined (and weighted) output of the five Modes of Interpretation applied to the text. Colors are a superb medium of portraiture for the aesthetic character of a text, since *color space* is a complete micro-consciousness of *pathos*, just like taste and smell. Mapping the outputs of each Mode of Interpretation into color space is also a most practical way of unifying the outputs of various interpretations into a single undeconstructed gestalt. For example, consider the problem of unifying the visual and affective perceptions of the word "sunset." In color space, this unification is practical: remembered visual swatches of past seen sunsets can be epitomized as a color palette, and sentimental entailments, such as "warmth, fuzzy, beautiful, serenity and relaxation," can also be mapped into a color palette, by applying psycho-physiological mapping heuristics learned from the color surveys of Berlin & Kay (1969) and Goethe (1840). When the color palettes resulting from the various Modes of Interpretation are merged to produce the color grid, our goal of conveying the text's singular, complex aesthetic character to the perceiver is facilitated by the eventuality that the human eye will blend these colors together, and attend to their undeconstructed gestalt rather than to each square individually; hence, the aesthetic character is not a simple sum of individual color squares, but rather, it becomes that Spirit which lives *in-between* the color squares. As we have learned from our own prior work, the ambivalent and perhaps mystifying nature of colors makes them powerful vehicles for conveying the aesthetic precisely because the aesthetic thrives in spaces of connotation, and is inhibited in spaces of denotation (Liu, 2004).

### Presentation Particulars

The Aesthetiscope is currently installed in a "living room of the future" at the MIT Media Laboratory, and is projected onto one of the room's walls. The grid of color squares is 16 wide by 9 tall, flanked by black striping on top and bottom. There is a "glimmer" effect added to the colors in the grid, as their Values (i.e. Value, as in the Munsellian Hue-Value-Chroma system for colors) wax and wane according to various periodicities. Finally, the glimmering of the color grid refreshes at 24 frames per second, to complete the cinematic quality of the piece.

We intend for the Aesthetiscope not simply to stand alone as a showpiece but also to play a supporting role for other activities in the room. By visualizing the aesthetic character of a poem being read (this activity can be detected by our context-aware room), or of the lyrics to a song being played over the room's stereo system, we can imagine how the *pairing* of the Aesthetiscope's color grid with the poem or song might enhance the *bandwidth* of an aesthetic encounter, just as the tasteful pairing of food and wine enhances the experience of both.

Having surveyed the major intentions and rationale behind the Aesthetiscope as an art installation, the next two sections examine the two components at the technical nexus of the Aesthetiscope's aesthetic visualization of text: 1) a novel computational model of aesthetic reading, and 2) a mapping from the *keyword evocations* outputted by each Mode of Perception into color space, informed by theories of color psychology.

## A Computational Model of Aesthetic Reading

The computational model of aesthetic reading developed in this work is of a basic and practical nature. The apparent fundamental distinction between literal and aesthetic readings, as noted by Rosenblatt (1978), is that literal reading is quite rational in nature, while aesthetic reading engages other ways of perception, including intuition and feeling. To reflect the fact that aesthetic reading is not just a monolithic rational process, but actually an amalgamation of various ways of perceiving text, we adopted a perspectival strategy to reading. Jung's four fundamental Modes of Interpretation – Thinking, Feeling, Sensation, and Intuition – plus a fifth – Barthes' Culturalizing mode – are applied to a text. Each mode represents a distinct textual analysis process over the text, and outputs a set of reactions to the text known as *aesthetic evocations*, which may take the form of a color palette or keywords (which, as explained in the following section, are also mapped into color space). The weighted sum of all aesthetic evocations generated from a text constitutes a basic *aesthetic interpretation* of text. While a produced visualization will typically mix the interpretations of multiple modes, to demonstrate the interpretational extremes of each mode, Figure 2 shows the four season keywords interpreted through each of the five modes individually.

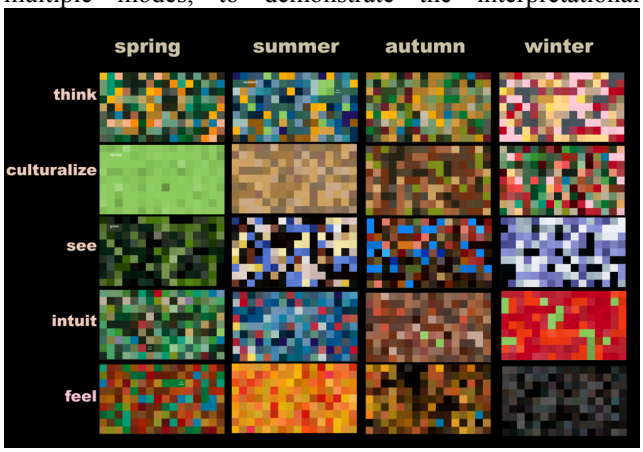


**Figure 2**: Visualizations of the four season keywords (columns) through the optics of one interpretive mode taken at a time (rows).

While the five Modes of Interpretation are not exactly orthogonal, the affordances of being able to divide up the grand task of aesthetic reading into modular components is practically quite useful, as each can be developed and improved in modular fashion. To operationalize the five modes, five distinct *textual analysis engines* were built, each having a unique interpretive logic. Since this alone entailed a rather goliath effort, we made the simplifying assumption that each interpretive engine would only try to understand the text at the *textual* level, rather than at the *narrative* level; that is to say, a poem is treated roughly as a bag of local conceptual features such as key phrases, rather than attempting to compute an understanding of the narrative as a globally integral entity.

Below, we briefly discuss the implementations of each of the five Modes of Interpretation. To preface this discussion, while the approaches taken by the textual analysis engines for Sensation and Intuition were quite straightforward, the approaches taken by Thinking, Culturalizing, and Feeling are based upon our previous research in methods for the rational and affective analysis of text. Due to space constraints, we cannot judiciously defend the design decisions behind each of these approaches, but we do invite the interested reader to follow the literature pointers to the related research.

**Thinking.** The rational entailments of a text are computed using Liu and Singh's ConceptNet commonsense reasoning system (2004) – a framework which is well-suited to the task of making rational inferences. ConceptNet 1) takes as input a whole narrative, 2) parses the narrative into a linear sequence of events, 3) maps those events into the nodal ontology of its semantic network, which consists of 100,000 everyday world concepts and 1.6 million semantic edges (causal, spatial, and social), and 4) uses spreading activation to compute inferences about the narrative, including spotting the main topics, and making temporal projections about next events implied by the text. ConceptNet is ideal for computing rational entailments because its knowledge represents some form of common consensus (between 15,000 web contributors to the project) about how things and events affect each other in the everyday world. For the interested reader, (Liu & Singh, 2004) contains examples of the types of common sense inferences made by ConceptNet.

**Culturalizing.** Semiotician Roland Barthes' structuralist theory of culture is that each culture can be represented as a sign system (1964), where each sign correlates to some set of *signifieds*, and the nature of the correlations is dependent upon the value system of each culture. For example, the sign "*sex*" signifies something negative and taboo in a religious culture, but not in a more socially progressive culture. Using this simple representation of culture, we have begun to compute cultural models for some broad cultural groups like American pop culture, Catholic culture, American feminist culture. We do so using the What Would They Think? system (Liu & Maes, 2004), which is capable of compiling together a model of a person or group's attitudes toward various subjects (in our case, toward *signs*) by automated analysis of a corpus of

texts compiled on the person or group. What Would They Think? works by detecting that certain topics are talked about in a consistent tone of voice; for example, "movie stars" in American pop culture, signifies "wealth," "glamour," "good," "popular" etc.

For the particular implementation in the Aesthetiscope, we use only the cultural model for American pop culture. The model is extracted from a text corpus we compiled consisting broadly of news articles from a variety of popular periodicals such as People Magazine, MTV News, etc. In future work, we hope to detect the cultures possessed by the perceiver and to dynamically load those cultural models to drive cultural interpretation of a story.

**Sensation.** By sensorializing text, we mean that the reading of a narrative triggers the remembrance of past visual imagery, sounds, smells, etc. The current implementation, however, addresses only visual imagery, but there is no reason why other sensory modalities could not be addressed in the future to produce a fully synesthetic experience.

From keyword-annotated stock photography collections totaling over 30,000 images, we have mined out the essential color palettes of various objects and events in the world, like "taxis" (they are yellow, at least in New York), "weddings" (lots of black and white), etc. These constitute a corpus of visual color memories. The outputs of the Sensation Mode of Interpretation are keyword evocations like "color of taxi," and "color of wedding." In the color rendering phrase (discussed in the next section), these phrases are resolved as their corresponding color palettes which were mined from the stock photography corpus. These palettes are merged with the palettes resulting from the other Modes of Interpretation into the final palette that is used to drive the Aesthetiscope visualization.

**Intuition.** Intuition, unlike Thinking, or Sensation, involves no remembrance or reasoning. As memory researcher Tulving put it, intuition is reflexive and instantaneous, it is simply "knowing" (1983). One way of measuring the intuitions around concepts is by recording free associations. Psychologists Nelson, McEvoy & Schreiber have compiled together decades worth of research into a corpus of free association norms (1998). For example, in the corpus, the concept "traffic" triggers "car," "light," "jam," "sucks," "stop," "noise," etc. Of course, we must realize that this measurement of intuition is specific to a certain population of people during a certain temporal period; nonetheless, we believe this corpus of free associations to be of high quality for our purposes.

We use this resource at face value in the Intuition process. From a story, we extract out a weighted vector of the nontrivial concepts contained in it and calculate all the free associations to these concepts. We can interpret the set of these free associations resulting from a text as *divergent thoughts* provoked by the story.

**Feeling.** We compute both the surface and deep sentiment of a narrative by combining the Emotus Ponens textual affect sensing system (Liu *et al.,* 2003), and Peter Roget's lexical sentiment classification system (1911). Emotus Ponens parses a story into events and evaluates the affective connotations of those events (thus it is sensing the affect of the deep structure of text). For example, "getting into an accident" connotes fear, anger and surprise. Roget's 1911 English Thesaurus features a 10,000 word affective lexicon, grouping words under affective *headwords*. We use this classification system to evaluate the surface linguistic sentiment of a story. Combining the affect sensing capabilities of Roget and Emotus Ponens, the Feeling process projects an input narrative into the space of affective keywords.

## Psychological Color Space

Having completed an aesthetic analysis of the text, we are still faced with the challenge of mapping *keyword evocations* into the space of colors. Many theories have been put forth regarding the psychological entailments of colors, and the color entailments of psychological states, including the cross-cultural color surveys of Berlin & Kay (1969), and the psychological color mixing theory of Goethe (1840). What we have done is to synthesize these theoretical conclusions into a computational model of the psychological color space.

### A Psychological Color Model

Our color space is an extension of that proposed by Munsell (1905), and has the following dimensions:

- Hue (e.g. green, brown, blue, purple, red)
- Temperature (e.g. hot, warm, cool, cold)
- Chroma (e.g. colorless, off-primary, primary)
- Saturation (e.g. low, medium, high)
- Value (e.g. dimmest, dim, medium, bright)
- Harmony (e.g. discordant, harmonious)

These dimensions are not orthogonal and so they overlap each other in dominion, however, they provide a broad descriptive vocabulary with which we can characterize colors flexibly. We have manually annotated an affective lexicon consisting of 100 frequent emotion keywords, and 180 Roger sentiment headwords (e.g. excitability, pleasure, pain, vulgarity, cowardice) with the descriptive vocabulary of Hue, Temperature, Chroma, Saturation, Value, and Harmony, according to the prescriptive color psychology theories of Berlin & Kay, and Goethe. A sample annotation is given below:

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Inexcitability = harmony-harmonious,
temperature-cool, hue-blue, chroma-colorless,
saturation-medium, value-dimmest
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Using this model of color psychology, the concepts vector outputted by the multi-modal aesthetic textual analysis are mapped into color space. Of course, not all of the concepts are affective keywords, e.g. *traffic light*, *wealth* etc. To

force these into color space, we use ConceptNet's PropertyOf and PartOf relations. For example, ConceptNet knows that a "traffic light" has the properties: "red," "yellow," and "green;" and that "wealth" has the property "desirable" which we can in turn map into color space using our psychological color model. Finally, the output of the Sensation mode consists of phrases like "color of taxi," "color of wedding," which are mapped into color space by recalling the memories of the color epitomes of those objects and events using the corpus we collected from stock photography collections.

### Gestalt Effects

Having collected together a palette of remembered colors (from the Sensation mode) and color descriptions (using the psychological color model we have developed), some color descriptions will emerge as salient. The most salient of these descriptions will affect the gestalt of the *whole* palette. For example, Chroma-primary causes the whole palette to shift to more primary colors, while Harmony-discordant causes the color squares to be rendered into the artwork using a *jagged* layout where similar colors are scattered across the grid rather than clustered. Gestalt

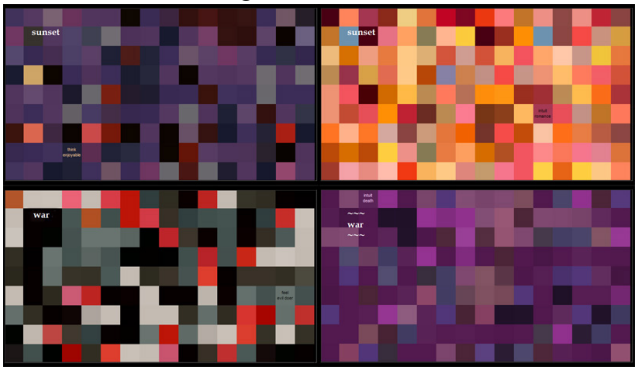


**Figure 3**: Visualizations of the words "sunset" (top-row) and "war" (bottom-row), as interpreted by a Thinking-Sensation dominated perceiver (left-column) versus an Intuition-Feeling perceiver (right-column).

effects are visible in Figure 3, which depicts the aesthetic visualizations of the words "sunset" (top-row) and "war" (bottom-row), as interpreted by a Thinking-Sensation dominated perceiver (left-column) versus an Intuition-Feeling dominated perceiver (right-column). The lower-left panel renders imageries of war as discordant, whereas the upper-left panel renders imageries of sunset as harmoniously blended.

## Discussion

After our initial installation piece, we received much encouragement, and many poignant suggestions from those who have experienced the Aesthetiscope, including psychologists, designers, colorists, and hundreds of others. Since then we have redesigned the presentation of the Aesthetiscope to incorporate their suggestions. In this section, we would like to briefly discuss some of our redesigns and reflect upon the competencies and incompetencies of the installation.

**Tailoring the visualization to the perceiver.** We have thus far mentioned only in passing that the relative contributions of the five Modes of Interpretation to the generated color grid can be adjusted by the perceiver. The adjustment of the weights for each of the five modes can be made by moving five sliders along a scale from 0% to 100% in a special control panel governing the behavioral settings of the Aesthetiscope. Our experience with the Aesthetiscope suggests that the generated color grid sometimes appears too busy and schizophrenic in what it wants to communicate when all five modes are set to contribute equally; however, the right balance between sophistication of palette and communicative clarity seems to be struck when any two Modes of Interpretation are set to contribute disproportionately more than the rest, as in Figures 1 and 3, where dominant modes are pairs like Feeling-Intuition and Thinking-Sensation.

In the collected experiences of those who have interacted with the Aesthetiscope, certain people tend to prefer to set the visualization to Intuition and Feeling as dominant modes, while others prefer Thinking and (Visual) Sensation as the dominant modes. One hypothesis which might explain why this is the case is the apparent predisposition of certain people's tastes to Realism, and others to Romanticism. We might even go out on a limb to suggest that a preference for certain Modes of Interpretation may be a reflection of a person's psychological type – this suggestion would certainly be supported by the fact that Jung's Modes of Interpretation were themselves proposed as a system to account for psychological types; and the now famous and widely-used Meyers-Briggs Type Indicator (MBTI) personality assessment system was derived from Jung's Modes of Interpretation theory.

**Letting the eye blend the image.** Initially, a two pixel black border separated the color squares. We heard multiple suggestions for removing this border so that colors could sit right next to each other, allowing the eye to properly blend the squares into a whole abstract image. Upon doing so, we realized that it unleashed a Pandora's box of problems, because without the border, contiguous blocks of similar colors seemed to form shapes! Initially, we had not considered the gestalt effects of laying out the color squares to either induce or prevent these emergent shapes, but now it was clear that we had to incorporate the layout into our model. In the current system, the nature of the layout, be it jagged or smooth, is a key aspect of the aesthetic being communicated.

**Contextualizing the abstract.** Some designers commented that although the abstract color piece was beautiful, it was not always clear how it is that the system was choosing particular colors, and what those colors were supposed to mean. Responding to this, we decided to

expose what the system was thinking, its perceptual process. Choosing randomly from the vector of concepts outputted by the aesthetic textual analysis, those concepts were made to pop up within random color squares for short bursts of time. A sort of "peek-a-boo" trace, if you will, with phrases for "sunset" like "feel awe," "think dark," and "intuit romance." This design feature gives the perceiver a sense of where the system is coming from, and was well-appreciated in the next iteration of the Aesthetiscope.

**Breathing life into the image.** Initially, the image was static, but we heard comments that it became much more engaging after we animated it. Each color square waxes and wanes in Munsellian Value, controlled by a Gaussian spring model with varying periodicities; the gestalt effect is that the image glimmers and "breathes." The engaging effect of perturbation is also observed by Ken Perlin, who, in adding some noise to a 3D model of a human face, observed that people found the new image to be much more lifelike (1997).

**An attempt to introduce shapes.** Some designers wondered about using different sized squares or shapes in lieu of the homogenous grid of squares. We have been experimenting with different shapes, but it has exposed us to new design problematics. When a color splotch is contained within a larger color splotch, a new psychological effect is introduced. As demonstrated in the work of artists experimenting with colors, such as Joseph Albers and his 'Homages to Squares' series, a rich color layered upon a thinner color can lead to a perception of gravitating inward, and the inverse arrangement leads to an even more psychological effect. If the inner splotch is placed centrally on top of the outer splotch, that is a different evocation than if it were placed on the periphery. These are just two examples of the new complexities introduced by heterogenizing the shapes. Until we can develop a more complete grammar of color and shapes and their psychological consequences, perhaps taking Albers' theories of color interaction (1963) as a point of departure, we will continue to use the form of a homogenous grid of squares, which itself, let it be known, has a great heritage in twentieth-century art, appearing as the subject of works of artists like Sophie Taeuber, Jean Arp, Piet Mondriaan, Paul Klee, and Ellsworth Kelly. Rosalind Krauss wrote this of the aesthetic of color grids: "The grid's mythic power is that it makes us able to think we are dealing with materialism while at the same time it provides us with a release into belief" (Krauss, 1979, p. 12).

**Where gestalt succeeds and fails.** We are thrilled by the apparent consensus from those who have visited the installation that a gestalt aesthetic seems to emerge from the abstract display. Even though the perceptions of the five realms of analysis are summed up so naively into a single color palette, the eye and mind seem able to pull out a single *aboutness* from the palette that the system could not have anticipated. Of course, the gestalt parameters of the rendering process helped, but even when perception was purely based on visual memories (so no gestalt parameters were in play), the eye seemed still able to find that singular Spirit of the abstract display.

In fact, the gestalt seemed to be weakest when Thinking was the main perceptual modality. One possible explanation is that visual imagery, intuitions, and feelings just blend better and more intuitively than rational thoughts. And people are not used to blurring thoughts; the nature of rational thinking is that it is highly focused, disciplined, and occurs in serial rather than in parallel (hence, *thought process, train of thought*). Or maybe Rationality is just not very aesthetic.

## Acknowledgements

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