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CHAPTER 1. INTRODUCTION

Two years ago I became interested in the paradox of how a television affords us the sense of witnessing realities while concurrently establishing a clear separation from real-time life by its very existence as a physical plastic box that contains images we view through a glass screen. My video studies of this simultaneous separation and seduction led to the production of increasingly pixelized and, in traditional terminology, abstracted imagery.

This inquiry into exposing contradictions between the physical and cultural nature of the video medium finally culminated in the reduction of an image to its most elemental form, pure primary colors. This discovery formed the content of my MFA thesis exhibition, PIXELS to PIXELS.

Television, as we normally understand and experience it, communicates to its viewers through the medium of video which usually contains "information" that presents time-based events in the form of weather reports, traffic reports, music-television (MTV), dramas, films, etc. This recorded video information describes various aspects of human social activities and the human condition as they relate to cultural interpretation. Given the broadcast nature of television, it also duplicates and disseminates applied data which gets decoded as communication to mass audiences. On the other hand, while these culture-reflecting data transmissions change constantly, the elemental properties of the video medium remain constant. It was this contradiction that inspired my early experiments with distorted video imagery, applying layers of video "noise" over the imagery, along with other methods designed to separate the viewer from the recognizable image.

Later, I began to focus on a digital process called pixelization which reduces cognitive elements from the video medium to non-cultural, non-descriptive color pixels. A pixel represents a color from RGB colors (red, green, and blue). Similarly, these colors are also fundamental elements in the human optical system. My work then evolved from barely recognizable distortions into highly pixelized abstractions comprised of moving RGB dots. It was just before the thesis exhibition that I understood the logical end to this directed research. I used individual and pure RGB colors to serve as elements of a visual language. I expected audiences would not be influenced by their knowledge, logic, and perceptions of the cognitive world as content when the video medium was minimized to self-describing colors. When experiencing these slowly modulating color changes, the purity and simplicity of the output elicits a primal response.

CHAPTER 2. IMAGING OF HUMAN EYES AND TELEVISION SETS

Although the technological and biological processes of producing and perceiving RGB colors seem to be opposite, the human optical system and television sets both function through systems based on RGB colors. Hence, by understanding the mechanics of producing and perceiving RGB colors in a television set and in human eyes, we should more easily understand the influences and responses of people to colors.

2.1 How Does A Television Produce Images?

A television set functions as a receiver of broadcasting stations, although a television set itself, physically and technologically, produces images and sound only. A television does not show programs without the broadcasting stations. Television programs are delivered to a television set by radio signals. These signals are decoded and become factors that control the strengths of magnetic fields and high-energy electron beams in order to generate moving images on a phosphor coated screen. Consequently, we recognize the images by combining and analyzing a hundred thousand moving, colored light dots on the screen, then interpreting them through our experiences, and generating logical and reasonable images in the brain. .

Television relies on components such as a CRT (cathode ray tube), LCD (liquid crystal display), or a plasma display to generate images. The inner phosphor layer of a television screen glows because of the collision of high-energy electron beams. The energy of electrons is converted to protons, which are seen as visible lights. There are three electron beams that illuminate RGB colors (red, green, and blue).

In a CRT, a cathode is a heated filament which is housed in a vacuum glass tube. The ray is a stream of electrons that naturally pour off a heated cathode into the vacuum. The cathode ray tube has two anodes, a focusing anode and an acceleration anode, which are located in front of the cathode. The focusing anode pours off electrons from the cathode. The acceleration anode then accelerates electrons which hit the phosphor screen.

In a color television, the screen is coated with red, green, and blue phosphor. Each phosphor responds to one of the RGB electron beams. If you look closely at a low-resolution computer monitor or television, you can probably see these three colored dots (a black-and-white television has one layer of phosphor only). When a red electron beam hits the red phosphor, a red colored dot is fired on the screen. The same thing happens to produce green and blue. When these three color beams mix together simultaneously, a white dot is produced. If all three beams are off, we see black on the screen.

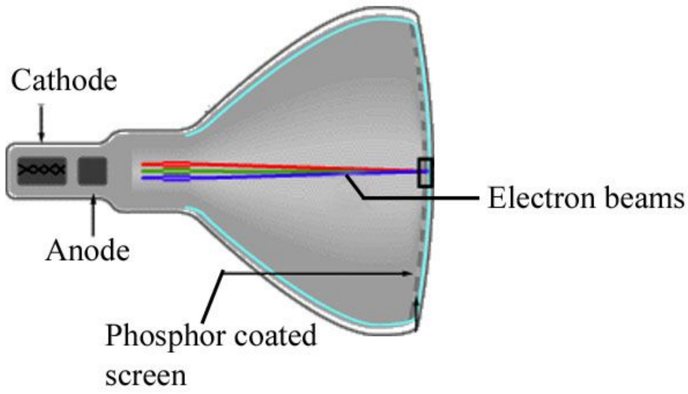

Figure 1. Structure of a television

2.2 How Do We "See"?

The retinas in our eyes perceive light. Everything except black objects reflects light to our eyes. We see a black object because it absorbs the entire visible spectrum of light (from 380 nm to 760 nm). Therefore no visible light wave is reflected to our eyes.

Color	Wavelengths / nm
Red	> 620
Orange	590-620
Yellow	570-590
Green	500-570
Blue	440-500
Violet	< 440

Figure 2. Visible spectrum and the range of wavelengths

The retina contains photosensitive cells, the rods and the cones. There are three types of cones. Each absorbs lights of different wavelengths, which are red, green, and blue (RGB color). Although a rod has an essentially similar structure as a cone, a rod only contains a single visual pigment and is unable to discriminate colors in the dark. However, due to its large surface area, a rod has a collective sensitivity for night vision, but in poor resolution.

These photosensitive cells when stimulated generate nerve impulses. These signals are carried by neurons of the optic nerves to the visual cortex, an area located at the rear side of the human brain. The visual cortex is an optically associated section that processes visual signals from the retina that results in seeing.

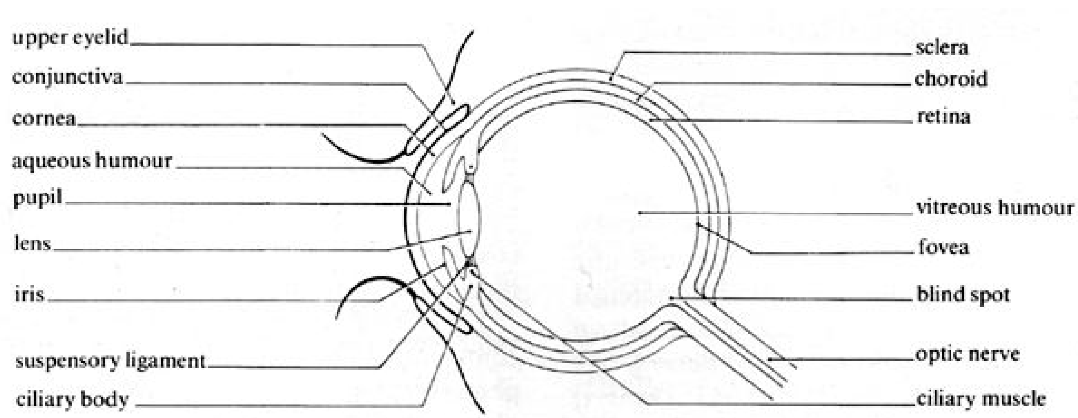

Figure 3. Structure of a human eye

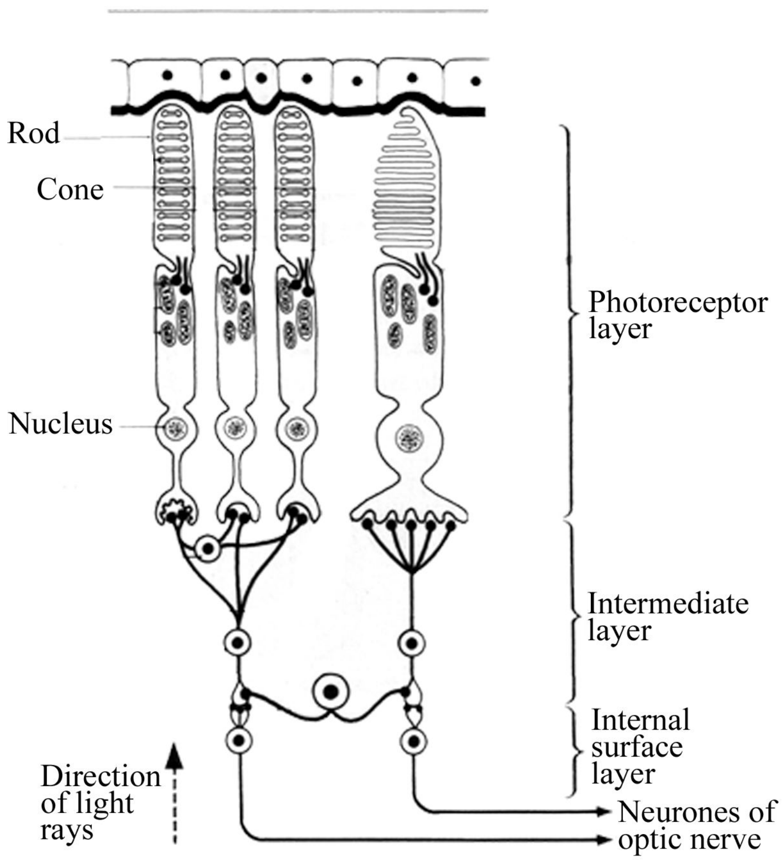

Figure 4. Structure of rods and cones

2.3 Human Optical System vs. Television Imaging

When looking at an image on a computer monitor or television closely, the color dots we see are too small for the brain to reassemble into a meaningful image. The dots are integrated into recognizable images when we look at the monitor from a distance. Image generation in the human optical system and the television system are similar. Both rely on tiny colored light dots. The human optical system perceives lights by cones and rods; a television set displays colored dots. A colored dot is a tiny unit (for example, there are 7656 dots in a square inch of a computer monitor) and each unit represents a single color at a specific level of brightness. We call this unit a pixel.

A pixel is the basic and smallest unit of an image (still or moving) in both digital and analog media. It is a fundamental unit containing no cognitive information. The following example indicates the relationship of cognitive and non-cognitive contents in a medium.

Newspapers, for example, provide local and world news as well as entertainment, yet paper and ink, the raw materials, or what we understand as the media of the newspaper, do not carry any readable content. To a reader, characters (texts) and photos (images) are readable and recognizable because ink composes lines (texts) and color (images) on the paper.

However, the properties of ink are its color and smell. Properties of paper are its color, texture, etc. Ink and paper do not contain news but rather compose it. The same situation happens inside a television set. The pixels compose videos, and videos tell the story. However, few people are really concerned about the physical property of such media. Printing was invented in 300 A.D. in China, and television channels started broadcasting in the early twentieth century. Both these visual media are dominated by cognitive content; indeed, the primal meanings of these media have been ignored.

Whether in a television set, the optical cells on the retina, or the paper and ink of newspapers, pixels alone do not carry any message except to signify colors and brightness. If we could shift our viewing focus from the cultural content of T.V.

programs to the physical action of the pixels on the screen, we could experience the more essential aesthetics of the video medium.

2.4 How Do We See A Pixel?

There are many ways to see tiny pixels clearly. The simplest way is to look closely at a television with a magnifying glass. The pictures below are captured from a television screen.

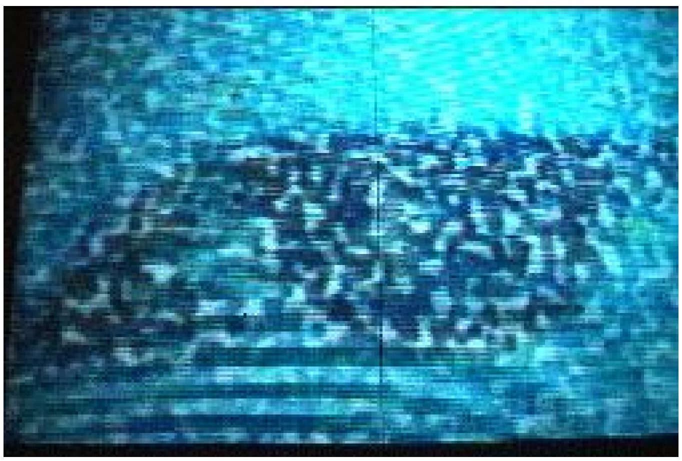

Figure 5. Screen shot from a television

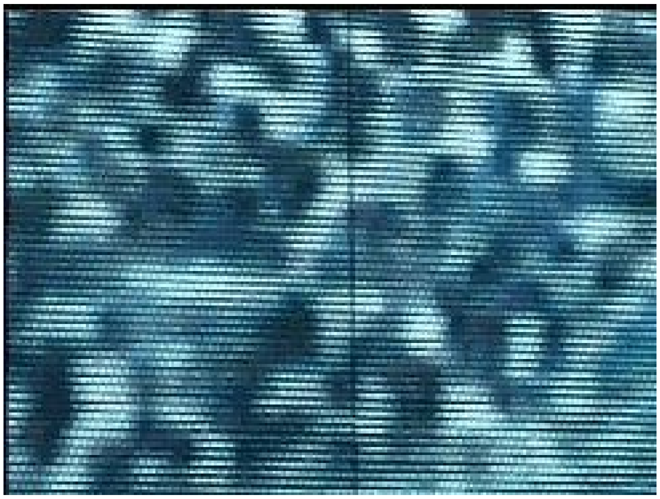

Figure 6. Screen shot of one inch sq. area from previous video clip

Even though television sets are precisely produced, it is sometimes hard to see the light spots on the screen. My research included efforts to exaggerate these spots of light. I shot a series of video clips of human sensory organs such as eyes, nose, ears, mouth, and hands, and employed basic digital image processing programs to magnify the video 50 to 100 times. This made the color dots predominant. Then these enlarged video clips were projected on a rough, white wall while another video camera re-captured the images on the wall. I repeated the process until football sized color dots could be seen on the wall. The finished video clips that derived from human sensory organs were then displayed on multiple televisions that were placed horizontally in a dark room.

Alternatively, we could isolate areas of pixels by magnifying the television screen or masking some areas on the wall or screen in order to limit the audience's view to a tiny section of the screen. However, this method would not conceptually erase the informative content which still existed but in a size too big to be easily recognizable.

This process of repeatedly projecting and capturing the video clips on the wall effectively reduces cognitive content from the video because a condition is created called D/A conversion imperceptibility.

2.5 D/A Conversion

D stands for digital and A stands for analog. Digital technique presents data by absolute values, 0 and 1. The following example indicates the wavetable of a natural sound. We zoom into the wavetable in order to observe the waveform of the sound.

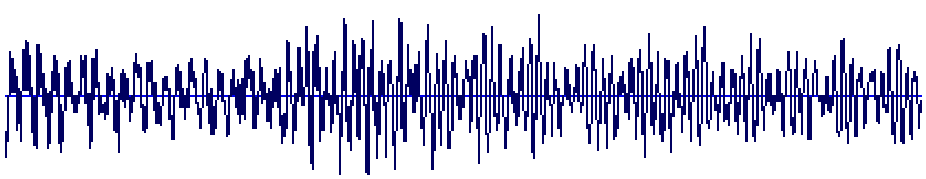

Figure 7. Sound wave

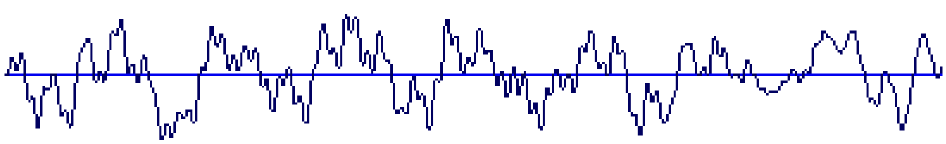

Figure 8. 4X zoom-in

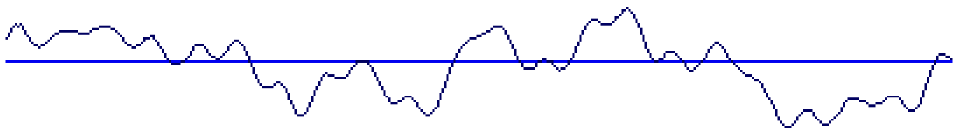

Figure 9. 16X zoom-in

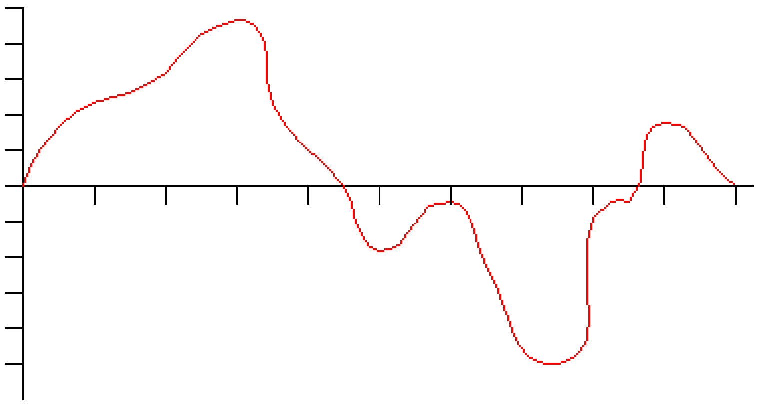

Figure 10. 32X zoom-in

Theoretically, digitized data can be duplicated infinitely without quality loss. Unfortunately, in some situations digitized processes do not honestly represent physical existence. In Figure 11, the red curve represents analog sound and the blue line represents digital sound. When analog sound is converted to digital, the D/A converter (computer hardware and/or software) picks up the closest number between 0 and 9 on the x- and y-axis. Therefore, an analog sound wave cannot be totally reproduced in digital format. Although we can demonstrate more accurately by increasing the sampling rate, we are still unable to completely represent a waveform with 100% accuracy.

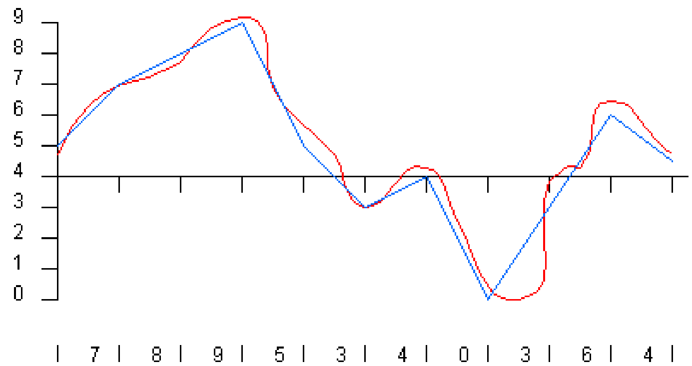

Figure 11. Sound wave in digital and analog

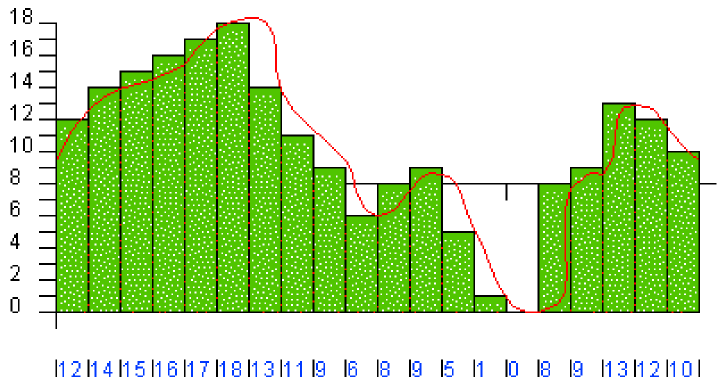

Figure 12. Lower sampling

Figure 13. Higher sampling

Theoretically, data in a digital format would not be reduced in quality and accuracy during recording, copying, and transferring. On the other hand, data in analog format may incur loss or damage due to sampling errors.

D/A conversion takes full advantage of sampling errors which successfully erase the informative content from the medium. When the video is projected on the wall, four factors influence pictorial quality during re-capturing:

- Roughness of the wall
- Reflection of the lens
- Dust and other tiny particles in the air
- Quality of videotapes

These four factors can be seen as analog factors because they are not absolutely controllable or able to be duplicated literally. These conversion processes incorporate random elements which help to prevent conscious manipulation and selection of personally desirable areas of color and movement. Such avoidance of aesthetic composing is necessary so that new informative information will not be added at the same time that other cognitive information is being removed.

2.6 Pixelization

The video clip on a videotape recorded in digital format is considered to be quality loss free. During projection and capture, the video data is converted to analog format through the four analog factors mentioned above. Next analog data is again restored in digital format. At the same time, instead of the whole screen, only a section of the video clip on the wall is captured; thus, most information regarding shape and composition is lost. Such processes are called pixelization. By repeating the pixelization process many times, colored dots and their movements are separated from a video clip that previously contained cognitive information.

This extreme reduction of video clips to colored dots diminishes the viewer's ability to cognitively relate the visual image to prior experience. Figure 14 is a screen shot from a video clip of a street and trees. There are ranges of grey-blue on the left and green on the right. A viewer might be able to read the content of the original video by decoding blue and green which may describe similar visual experience. Green often relates to trees. These videos were intended to explore the lines between recognition and experience in highly pixelized video imagery when the viewer was not informed of the original source material.

In my early work, viewers were not discouraged from making comparisons between the source and the output. The cognitive content of the source seemed to be insignificant to a viewer, but it served as a starting point for the uncovering of the medium of video. Since pixelization can reduce cognitive video clips to non-cognitive colored dots, pixelization becomes an artistic solution that shifts a viewer's focus from cognitive concerns to the real video medium.

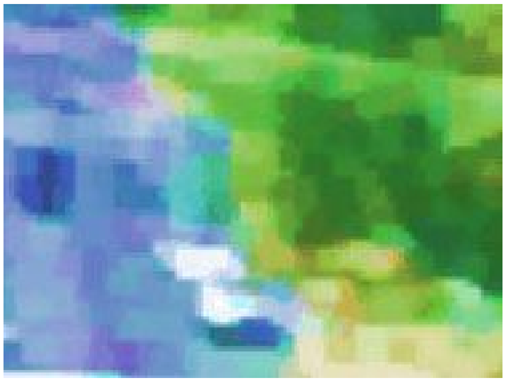

Figure 14. Screen shot of a pixelized video clip

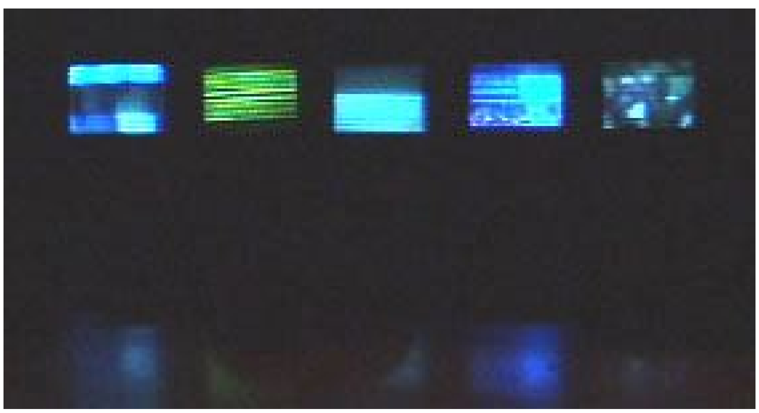

Figure 15. Five pixelized video clips placed horizontally

A fully pixelized video clip has no descriptive elements such as readable text or recognizable images. Single color compositions in these video clips do not contain specific messages about culture, language, and individual characteristics. The pixelized video clips become increasingly abstract and minimally descriptive.

In addition, when the cognitive contents have been taken away from the video clips, the characteristics of a television set change. A television set no longer refers to a machine that transmits radio signals from broadcasting stations. A television set is then reduced to a mechanical device that produces colors. After the reduction, a television set conceptually becomes a screen.

A screen contains images that we cannot recognize by comparison with experiences and knowledge in the conscious databases of the brain. We are not able to process interpretations of images on the screen through our acquired cognition of the world. On the contrary, we only recognize a set of colors, continuously and randomly moving around the screen.

CHAPTER 3. OBSERVATION AND CONCLUSION

3.1 Go Deeper Into A Pixel

The effective reduction of television programming to the essence of the television screen allows comparison with the fundamental properties of the video medium that we usually ignore. While the television we normally watch is dominated by broadcasting stations as well as the programs they provide, the attention of the general public is on the programs rather than on the characteristics of pixels. Content on a television is more meaningful to the general public than pixels on a screen.

Why is it important to pay attention to the pixels on a screen? Discrimination of pixels on the screen relates to matters of nature. As infants, our first impression of the world is conveyed through the sound of a tone from our mother's voice, light from a bulb or through the window, or conversation surrounding us. As we grow up, we are taught by parents and peers. We are educated in school. We learn from society. We learn our culture and tradition and compare them with others. Somehow we are taught how to distinguish conceptual dilemmas such as good/bad, beautiful/ugly, interesting/boring, pleasure/pain, etc. Emotional discriminations of this nature are not congenital; however, they serve as indirect evidence of how we represent the contemporary existence of society.

As we mature, we are progressively influenced by society, fashion, cultures, and traditions. The essence of our less culturally conditioned reality from our early years of existence still remains.

In the attempt to re-discover this reality, abstract expressionist painters rapidly and impulsively drip and throw paints on canvas. Their works are characterized by a strong dependence on what appears to be accident and chance but are actually produced by processes that draw on both conscious and subconscious reasoning. They seek natural purity and the ideal and understand that this “real” occupies a primary and secret area in the mind.

Each person attaches his/her own meanings to special objects and events according to his/her background and culture. For example, meanings attached to colors vary in different cultures. Red often means danger. A red traffic light usually indicates stop. Red is a specific symbol of the New Year in Chinese culture. On the other hand, the ability to determinate color is congenital. Humans have natural responses to colors. Such responses exist regardless of cultural influences. In scientific terms, different wavelengths of light cause certain kinds of emotional stimulation in humans. For instance, people who receive light in a frequency >620 nm (red in the visual spectrum) appear nervous and excited whereas 500 - 570 nm (green in the visual spectrum) relaxes the nerve system.

Also, each person has a unique DNA sequence. DNA is a nucleic acid molecule that carries genetic information. Scientists have supplied evidence that human behavioral responses and brain processes, such as the abilities of learning, discrimination, interpretation, and organization, as well as cognition, perception, emotion, and behavior, are controlled congenitally. Such facts suggest that we have a hidden aspect of response to color that could be similar to or diverse from responses we learn from specific environmental and cultural interraction.

I am interested in reducing the cultural impact of a television set to the aesthetic impact of purity on a screen. In addition to my interest in viewer reaction to colors as pixels, I am also interested in comparing the relationship of a television set and screen with conscious and subconscious activities. How we distinguish between a television set and screen varies according to the information given. In that the elemental units of a television screen are colors and movements that exclude culturally driven cognitive contents, I chose to use pixelization to focus on those units.

Pixelization reduces images on a television screen to primary RGB colors. Since pixelization serves to diminish cognitive contents from a video clip, a viewer’s brain is unable to interpret descriptive images and masks the influence from the conscious mind. Pixelization forces the viewer to experience pixels without the distraction of more complex cultural coding.

Pixels on a screen directly respond to the spirit of the viewer in the same way abstract expressionist artists seek the real by reflecting instant, emotional inspiration on a canvas.

3.2 The Thesis Exhibition

My thesis was to remove as much content as possible from the video medium by presenting pure red, green, and blue. Visitors experienced only these three primary colors in the thesis exhibition, PIXELS to PIXELS. The exhibition included eight television monitors that were installed linearly at a 30-degree angle in a closed, long space twenty-four feet deep. Thus the audience was kept a distance from the television monitors. Each television monitor displayed either red, green, or blue in an indeterminate sequence. The space was dark so that the forms of the television monitors approached invisibility. The visual result was eight rectangles of flattened colors that appeared be floating in a black space.

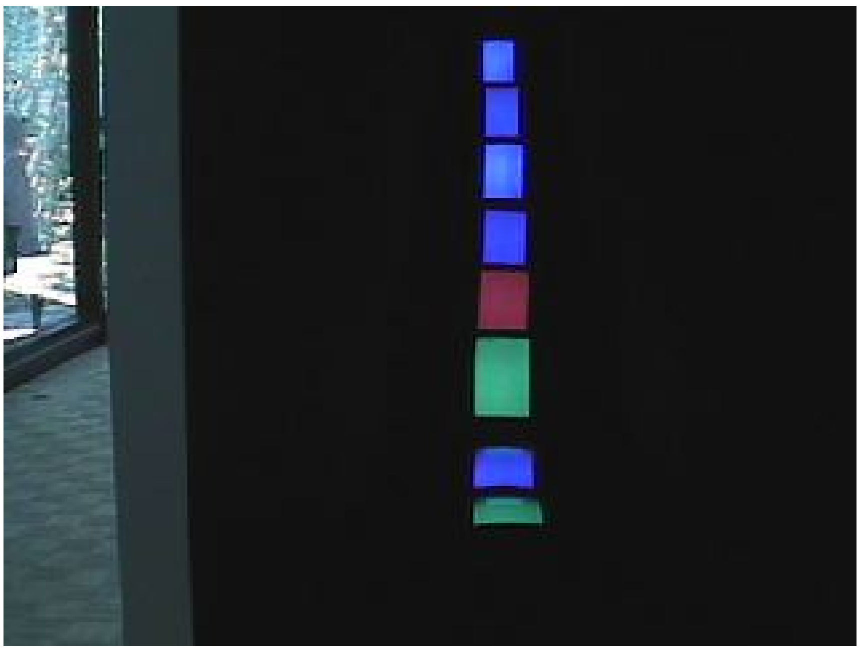

Figure 16. Thesis exhibition "PIXELS to PIXELS"

These eight television monitors did not show the kind of descriptive video images that a viewer would expect to see. Each video monitor contained no shots from recordable environments and no recognizable imagery or figure, shape, or color composition. The purity appearing on the television monitors approached the conceptual extreme of pixelization by way of exaggerated reductivism. The route to this end could be traced through my prior works where thousands of color dots appeared on screens. Conceptually, prior pixelized video clips were artificially enlarged by capturing, projecting, and re-capturing (Chapter 2). A one-inch square pixel on the screen was physically composed of thousands of smaller RGB color dots. This suggested that such visual pixels could be progressively reduced to a single dot of the RGB color.

Therefore, I chose to present the RGB colors as the elemental component of all visual colors. According to the trichromacy theory (Appendix A), a television set and human eyes are unable to generate and see a full range of color if one of the RGB colors is missing. For instance, a television with a damaged CRT can only display a single scale of red, green, or blue; similarly, colorblind people are unable to distinguish some colors because some or all of their cone cells are not functioning.

In my thesis exhibition, each of the eight video tracks was exported to video from a computer with a value of 255 which indicates a clear and pure color. In computer art technology, engineering emulates the trichromacy theory by controlling a variable amount of each RGB channel. There is a range from 0 to 255 on each color channel. 0 and 255 indicate the weakest and the strongest luminance (amount of light). Values of 0-Red, 0-Green, and 0-Blue are seen as black, and values of 255-Red, 255-Green, and 255-Blue mix a pure white.

It was my intent that viewers would respond to this presentation of the video medium directly and honestly as they confronted the RGB color environment.

Electronically, the CRT in a television set projects one electrical beam at a time, either red, green, or blue. This physical reduction of composition upon the phosphor coated screen is consistent with the conceptual reduction of composition by the artist. At the same time, the cone cells in the eyes of the viewers were simply activated by RGB colors. Since the colors carried little cognitive content, the brain could describe those colors with minimal interruption from the baggage of prior knowledge and experience.

Parenthetically, I interviewed some visitors to the exhibition. Not surprisingly, some of them did not understand why there were only colors on each television set. Their written comments such as “Interesting”, “quite simple”, “COOL”, “Wicked”, “Romantic”, etc. imply that even though they did not receive a specific message or exhortation from the show, they were, for the most part, positively responsive to their experience of a visual massage of color. I expected to see these emotional and non-descriptive responses. Apparently when people looked at the purity of RGB colors, the complexity of the conscious mind was minimized.

Increasing complexity in the world causes more complexity in the conscious mind. For decades, the fashionable art style has reflected the fact that conceptual distance between peoples is shorter. The rate of exchanging, creating, sharing, and renewing information is increasing rapidly. Multi-cultures and mutli-languages are replacing the individuality of peoples and cultures. Such social movement is reflected in artworks that combine different languages, characters, and symbols from different cultures. This artistic style is rich with meaning and content.

The reduction of art into basic colors in my thesis exhibition counters this social movement. I was born in the 1970s when society was rapidly becoming more complex. The number and variety of channels for spreading and sharing information escalated. Newspaper, television broadcasting stations, the Internet, music, and magazines packed with information and events were delivered to us daily. The information generated is more than we can possibly digest.

Some people think that humans take full advantage of this information age because we have the opportunity to pick up the information we need and are interested in. Some believe that communication between people will not be limited by regional separation because information can be instantly transmitted in electronic format. In the early 1990s when the Internet started to become part of our lives, many people believed we were stepping into a multi-cultural age and/or mixed-cultural age because so much information was able to be shared in cyber space.

While we currently review such doctrine, we see the dream of a multi/mixed cultural age is still elusive. Cultures and people are still separated by languages, traditions, religions, and politics. People in different regions of the world are still speaking their own languages and writing in their own characters. The concept of the Internet as a Global Village has not been realized. Cyber space has already been divided into localized and fragmented communities. Yahoo, the biggest Internet searching engine, introduces several search engines in different languages. Each localized search engine collects and provides information on websites located only in specific countries and regions.

Further, the outcome of the multi/mixed cultural movement is that our lives are overloaded by an immense quantity of information. Unfortunately, information is repeated in various media. A daily news headline is repeatedly reported in television channel news, newspapers, radio, and magazines. A Hollywood film shown in theatres will soon be published on a DVD disc. Although we do not need such duplicated information, we are accustomed to receiving it.

The artwork in my thesis exhibition counters this chaos. The geometric installation of television sets that display only colors serves to critique the video medium and its socially inherent complexity. The installation concurrently refers to minimalist artists of the 1960s who drastically reduced composition and content. Limiting the function of a television set suggests a possible minimization of technology and its influences. Limiting the number of colors on the screen reflects the way our optical system works and also works in conceptual opposition to complexity and the chaos of multiple color compositions that overload us with information.

Technology may improve our living quality but tends to make the world more complex. Technology also tends to isolate our personal spirit from the physical world by homogenizing the information we receive. Consequently, personal individuality and creativity begin to be dismantled. I do not want viewers to imagine anything cognitively while looking at the installation. Instead, I hope that the singleness of colors in my thesis exhibition releases one's mind from the confused and busy world and reinforces the spiritual individuality in each person that facilitates creation and imagination in our lives.

APPENDIX A: TRICHROMACY THEORY

Color vision is explained in terms of the trichromacy theory which states, “different colors and shades are produced by the degree of stimulation of each type of cone stimulated by the light reflected from an object.” Young and Helmholtz postulated the trichromacy theory in the nineteenth century. The theory is based upon color matching experiments carried out by Maxwell who demonstrated that most colors could be matched by superimposing three separate light sources known as primaries through a process known as additive mixing. For example, equal stimulation of all cones generates white. Certain amounts of blue and green light stimulate cones to generate yellow.

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