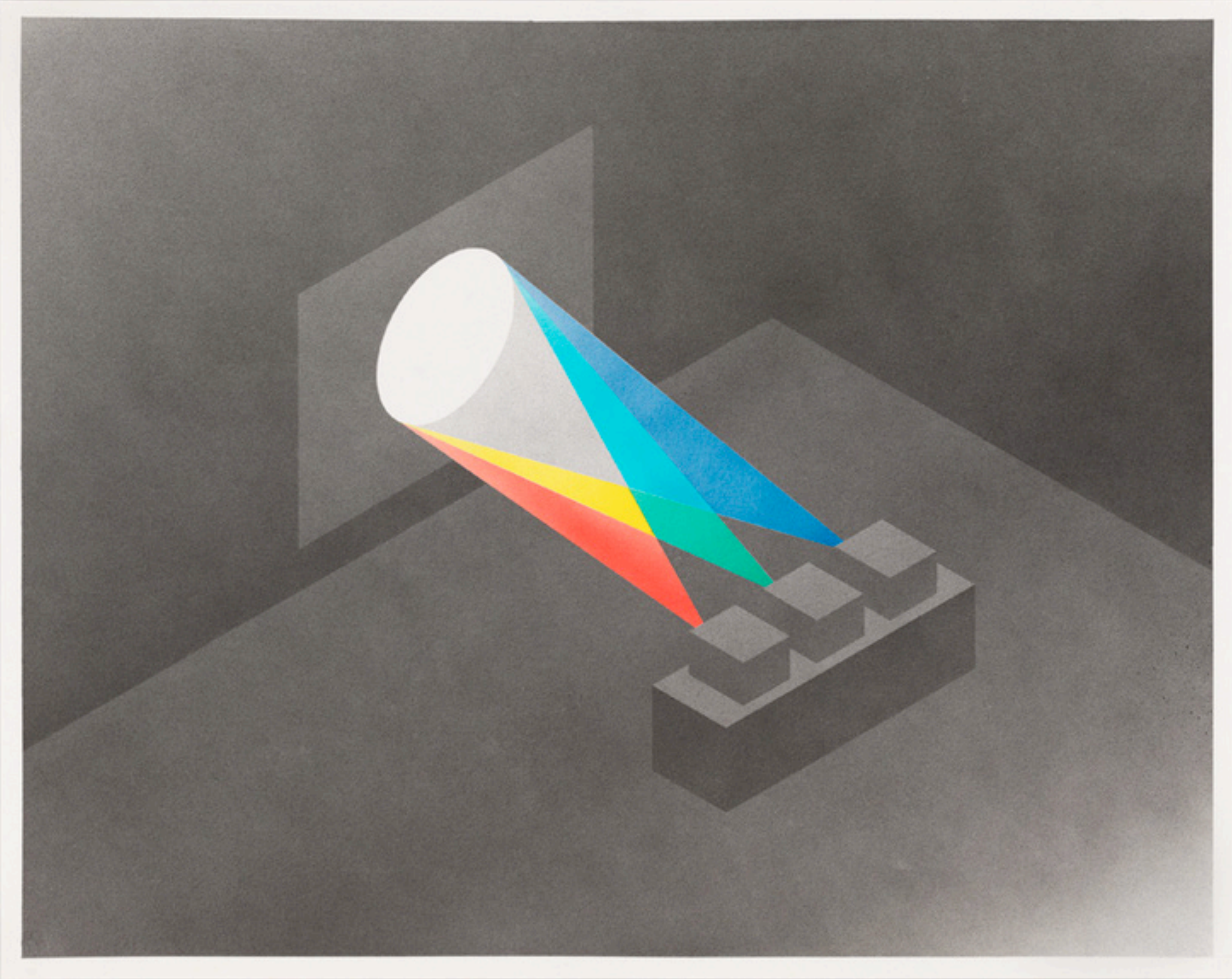

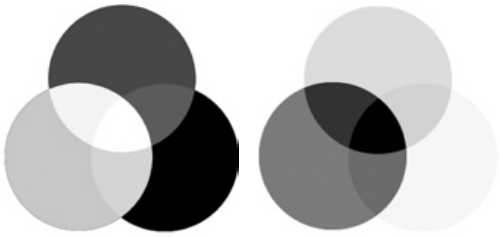

Related by Nick Relph

One of the defining characteristics of being human is thinking of ourselves and our species as distinct from nature. Successive developments in language and technology over thousands of years have created a perceptual divide between man and his environment. Taken defensively, this split flatters us with the delusion that we might conquer the forces of nature with sheer intellect. Viewed outwardly, from the vantage point of our light-absorbing, achromatic cities, this organic Other appears benign, "green." But just as the countryside itself is in some sense an elaborate construct, the color green, like all colors as we comprehend them, is a result of the human physiological response to the outside world. Color is not an objective fact but a judgment contingent on a number of variables—an isolated color can appear drastically changed under altered levels of ambient light, different times of day or by the other colors that immediately surround it—it is neither strictly truth nor fiction but very much man-made. The rainbow, often used as shorthand for the sublime of the great outdoors, may be better understood as a fleeting manifestation of interiority.

Both light itself and the objects that surround us have no intrinsic color value—the spectrum of colors we can see simply represent electromagnetic light energy radiating at different wavelengths, from red in the lowest frequency through to blue in the highest. Because frequencies such as infrared and ultraviolet sit outside our limited range of vision we don't consider them colors. However, some animals can see beyond this range—bees, for example, can see ultraviolet light and are regularly seduced by flowers sporting UV patterns completely invisible to us.

There are two models used to describe the ways in which we see and use color, and in order to explain both it is first necessary to understand a few things about the relationship between our eyes and brain. Humans are trichromats, meaning our eyes have three types of receptor cells (unlike, say, dogs, who along with most other mammals are dichromats), known as cones, which handle color information and are adapted for use in daylight. In addition to approximately 6 million cones, we are equipped with 100 million or so "rod" cells, which do not aid color vision but are instead responsible for seeing in relative darkness. Being positioned outside the fovea —the middle part of the retinal wall that deals with highly detailed, centralized sight—rods instead serve both our peripheral and low-light vision with diminished clarity and speed and, as a consequence, sight in the periphery relies heavily on "filled in" information supplied in part by a fog of memory and the imagination.

The first of the two color systems is the ADDITIVE model, which correlates directly to the color-processing structure of the eye outlined above. It might be useful now to imagine ourselves in the dark—the premise of the principle ahead. Additive color describes the color sensation of emitted light. Beginning with an absence of light (black) colored light (typically red, green and blue) combines towards the creation of white. Where two of these colors overlap, we see the additive secondary colors cyan, magenta and yellow, and when all three primaries collide, we see white.

The standard additive colors are R(ed) G(reen) and B(lue) because each individual color most directly stimulates one of the three different types of cone photoreceptor with minimum "overspill" into the other two. The cones send this separated color information via the optic nerve to the visual cortex, where the three signals are combined again to form a full color image in the brain. Visual recording technologies such as digital cameras and scanners are based on the same principle. The camera, for example, allows light to travel through its lens and onto a bed of photosensors positioned under a mosaic of tiny RGB filters, which permit only their respective color to pass through and reach the pixel beneath. The camera's processor, acting as the brain, reassembles the RGB channels using "demosaicing" algorithms to produce the final color picture.

Now imagine you've taken a photograph of a common yellow-green tennis ball on black asphalt, and wish to make a print on an average inkjet printer. This machine utilizes the other color system, known as the SUBTRACTIVE model. Whereas additive color deals with emitted light, its counterpart is concerned with qualities of *reflected* light, and accordingly the sequence of processes is inverted. The starting point this time is white, which reflects all wavelengths of light, and black is obtained through the *removal* of color. This removal is attributed to the absorbance properties of a given surface. The tennis ball only appears yellow-green to us because it absorbs all other frequencies of light *apart from* yellow-green.

The subtractive primary colors are C(yan), M(agenta) and Y(ellow), and in another inversion of the additive model, the primaries of additive RGB are now the secondaries of subtractive CMY. In other words, red, green and blue are produced when any two of cyan, magenta and yellow are combined. These colors, along with a supplementary black (usually referred to by its last letter K to avoid confusion with blue), are those found in full-color print technologies, from high-end lithographic presses to modest inkjet printers. To reproduce the image of the tennis ball, nozzles inside the printer deposit a large amount of yellow and a small amount of cyan in tiny beads which appear to the eye as a solid color. This new color most effectively absorbs the blue-red frequencies that are the tennis ball's opposite, and therefore appears recognizably yellow-green and tennis ball-ish on a sheet of paper. This print then triggers a response within the viewer's cones to levels of RGB light reflected off the page. In this sense, the subtractive process is a mimic of additive color by material means.

CMYK is the current result of thousands of years worth of subtractive experimentation in which countless colorants were discovered and tested for their hue, fastness and mixing characteristics. Until relatively recently the chemical makeup of material colors was poorly understood—paints, dyes and inks would behave erratically and in combination could produce frustratingly counter-intuitive or inconsistent results. An affordable, stable colorant was an immensely valuable discovery, which naturally led to market competition, and many colors were held in high esteem. The history of subtractive color, however, is less a hard science and more a catalogue of compromises governed by the dictates of existing technology, natural resources, property and consumer demand. This essential messiness is a consequence of a fundamental difference between the two systems.

Subtractive color mixing takes place in the outside world, defined by the additive effects of light on material surfaces and (when applied) the light-*manipulating* attributes of any number of different paints, inks or dyes substrates such as wood, concrete, fabric or paper. Which is to say that color is inextricably bound to objects, to their weight, their "thingness." From cave paintings, through the advent of the written word, the printing press and on to any pre-20th century work of art, subtractive principles have defined the way we think about and use both our environment and the things within it. The industrial revolution fostered synthesized pigments, making it possible to create a far greater variety of colors, which, when married to the radical transformation in manufacturing, meant more things in more colors more often. This also resulted in birth of the modern chemical industry, near universal standardization and the "proprietary color spaces" of companies such as Pantone.

In contrast, additive color mixing takes place not in the external realm but in the retina. If you want to project a video recording of your tennis ball through your home cinema system, the colors present in the footage are mixed not on the projection screen itself but in your eyes, which take in and combine all wavelengths of light within your field of vision. The color sensation of the same image reproduced via additive and subtractive means might be very similar, but their physical processes are quite different. Subtractive/CMYK technologies necessarily involve two stages prior to reaching the eye—a light source of some kind and a treated surface upon which it absorbed and reflected—and this dependency on the context of one's surroundings forges relationships between what is being looked at, the immediate environment and the viewer themselves. Additive/RGB systems compound the illuminant with the visual information and in this sense at least is the more economical process of the two, providing a direct channel between the emitter and receiver, canceling out space and fixing one's vision strictly forward.

Aside from some early color photography in the 19th century, the employment of additive mixing didn't begin in earnest until the middle of the 20th century with the widespread adoption of color television around the mid-to-late 1960s, and it is often said that during this time the world "went color." TV involved the emission of multiple channels of moving color from a single device. The distribution of visual information was quickly changing, becoming ever more immaterial, and this change became more rapid still with the arrival of digital imaging, personal computers and, of course, the Internet.

By now it is widely understood that the mainstream technologies of print and film, along with their respective infrastructures, are in danger of being supplanted by the new systems of production and distribution afforded by digital technology. And yet there is a marked absence of commentary about the fact that this involves a major shift from subtractive/CMYK to additive/RGB as the dominant color system.

Just as subtractive color is founded on the principle of selective removal, by limiting which wavelengths reach the eye, subtractive media (i.e. those based on subtractive color) presuppose an analogous *editorial* process. The cost of 35mm film stock, for instance, necessitates tightly scripted scenes and carefully planned shots, while the conventional limitations and properties of a book effectively restricts channels, and usefully focuses its content. Both these examples of subtractive technologies require standardization and foster quality control, while the corresponding glut of possibility and very lack of restrictions are often cited as defining qualities of additive/RGB technologies such as the Internet. In the same way that subtractive color matches the structural logic of a steady, localized craft tradition and its subsequent industrialization, so the speed, efficiency, and weightlessness of additive color describes the structural logic of the information economy.

And so, as an entire color system is on the wane and another takes its place at the speed of light, it might be worth considering that in a quick online thesaurus check, the key to additive color, "emittance," results in synonyms such as "shine" and "glimmer," but also "vent," "gush, "and "vomit" ...