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Color, culture and identity: past, present and future

Color, cultura e identidad: pasado, presente y futuro

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Color and Cesia as Signs: Indexical Use of Color and Cesia in Culture and Nature

José Luis Caivano
National Council for Research and University of Buenos Aires
Color Research Program, FADU-UBA

Abstract

In this communication, the issue of indexical uses of color and cesia will be addressed, both in cultural contexts and in the natural environment, facing the question about the realms in which these kinds of semiosis can be present in nature.

Keywords: visual semiotics, chromatic signs, cesias, icons, indexes, symbols, culture, nature

Some Basic Notions of Semiotics and Signs

Let's review the triadic conception of the sign according to Charles Sanders Peirce (1860-1908 [1931-1935: 1.541, 2.228, 2.230, 2.274, 2.303, 4.536]). A sign is something that stands for some other thing (its object) in order to bring information or knowledge to a third agent (the interpretant). The substituting sign is called *representamen*, the *object* is the substituted thing, what is represented by the representamen, and the *interpretant* is the idea or knowledge that the representamen transmits about the object.

Charles Morris (1938) has described three dimensions of *semiosis* (the process of signification): the *syntactic* dimension, which refers to the relations of signs to one another, the *semantic* dimension, which refers to the relations of signs to the objects that they may denote, and the *pragmatic* dimension, which deals with the relations of signs to their interpreters or users.

In the semantic dimension, the relation of signs to the objects could happen in different ways, and this gives origin to three kind of signs, which in the peircean tradition are known as icons, indexes and symbols. The *icon* is characterized by holding relations of similarity to its object. The *index* points to its object by a relation of physical contiguity, through a necessary physical connection. The *symbol* represents its object by relations of conventionality, i.e. learned codes.

Within the indexical signs, Juan A. Magariños de Morentin (2007: section I.10) makes a distinction among three different kinds of indexes, according to the temporal relationship by which signs and objects are linked: *signals* are indexical signs that appear before their objects, *clues* are signs that remain after the objects that caused them, while *symptoms* are indexical signs that occur simultaneously with their objects.

Color: A Visual Sensation, a Visual Sign

In an article published in the journal *Color Research and Application* (Caivano 1998), the issue of the indexical function of color was approached with the following arguments:

It is a well known fact (or at least it is a widely accepted notion) that color does not belong as a property to physical matter, nor to luminous radiation. Color is an *image* (we could also say a *sign*) produced in the mind of an organism that is furnished with a sensorial system, such as vision, that reacts to certain portion of this radiation. This image or sign is the reproduction that the visual system makes of the radiation coming from light sources or from objects that reflect or transmit the radiation falling upon them.

This kind of reproduction or representation is the most primary function accomplished by color, i.e., the one by which color (as a sensation, image or sign) is constituted as a substitute of physical radiation in order to provide the brain with useful information about the external world.

In this particular context, color works mainly as an indexical sign, because it is evident that between the sensorial image (the sign color) and the physical phenomenon (radiation) there is no similitude or homology whatsoever, nor a codified relationship, but only a physical connection, a neurophysiological response, built during millions of years along the evolutionary process of visual systems (see Kuehni 1991).

In the human visual system, this connection is the one responsible for reacting to radiation around 680 nanometers of wavelength by generating a reddish color sensation, which stands out in an environment where usually green and blue predominate.

Cesia

Cesia is also a visual sensation. From different spatial distributions of the luminous radiation around objects (radiation that, in addition to being absorbed, could be reflected or transmitted, either regularly or diffusely by objects or surfaces), and from the visual context in which they occur, human beings get sensations of transparency, translucency, matte opacity, mirrorlike appearance, gloss, etc. (Caivano 1991, 1994).

These sensations of cesia also bring useful information to the brain. For instance a mirror image (produced by regular reflection, in one predominant direction) and a blurred image (produced by diffuse reflection, in multiple directions) tell us something about the characteristics of the surface in which these reflections and images are produced: the first one is smooth and polished, the second one is rough or textured (Figure 1).

Figure 1. A mirror image, produced by regular reflection (bottom left), and a blurred image, produced by diffuse reflection (middle right).

In a volume of water seen through a transparent media, a cloudy, translucent or turbid image is due to diffuse light transmission, or scattering, while a transparent or clear image is due to a regular transmission of light. As interpreters of these images, we may know something about the properties of the liquid that produce them, i.e. these images have certain meanings for us (Figure 2).

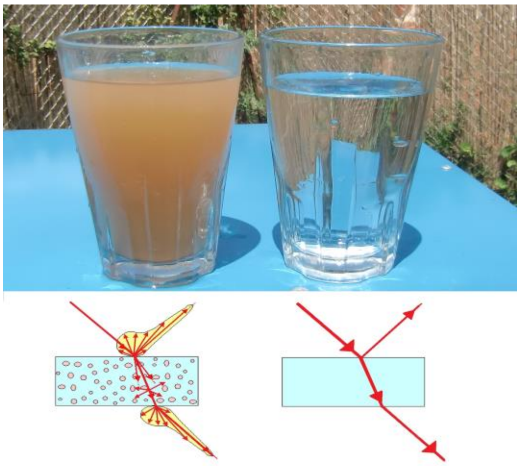


Figure 2. The visual appearance or cesia of liquids informs about their properties, working in an indexical way: turbid, translucent media (left), and clear transparent media (right).

With regard to the semantic function, likewise color, cesia is also a visual representation, a visual sign or image capable of indicating certain physical characteristics of materials, among other aspects. The most obvious and immediate thing is (by the fact that sensations of cesia are induced by physical properties) that cesia works as a sign for these physical properties. Thus, a sheet of matte paper tell us about an object that, due to its physical conformation, is capable of reflecting light in all directions, while if we see a satin or glossy paper we know that there is something different in the finishing of its surface that makes light to be reflected in a more directional way (Figure 3).

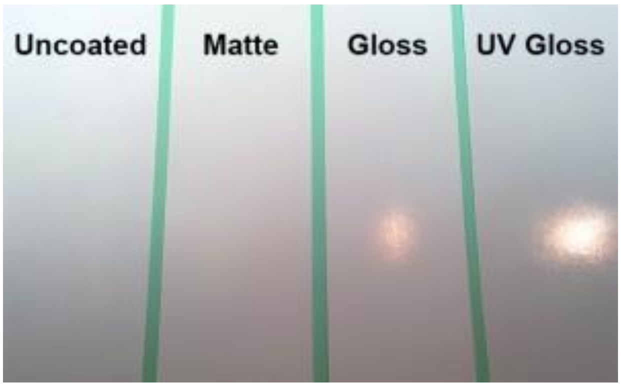


Figure 3. A series of paper surfaces with different visual appearances or cesias, showing increasing gloss from left (highly matte) to right (highly glossy). (image from The MGX Copy Blog)

Let’s see another example. We can detect scratches on a polished surface because the scratches are seen with a matte appearance, in comparison to the glossy appearance of the polished surface around them. The matte appearance is produced by the perception of diffuse reflection, and thus, in this regard, this particular cesia acts as an indexical sign, where the meaning comes form a relationship of physical contiguity between the sign (cesia) and what it denotes, the information it provides about the physical world.

Icons, Indexes, Symbols

In addition to the *indexical* function, color and cesia may have, of course, *symbolic* and *iconic* values. They can represent feelings and moods, produce associations with concepts; in other words, they can have different meanings, also by means of established, acquired or learned codes (when they behave as symbols), and by means of relations of similarity or resemblance with the represented objects (when they work as icons). However, we will concentrate here on the *indexical* uses of color and cesia.

Indexes in Human Culture

As an index, in general, color serves for identification purposes, to allow visibility, to facilitate distinguishing between objects and recognizing objects on a background. For instance, these are the main responsibilities of color in football matches and army uniforms.

More specifically, as a symptom (an index in which the sign and its object occur simultaneously), color is a sign that evinces emotions. Usually, fear is expressed by a pale face, while anger is expressed by a reddish face. The chromatic sign and the emotion occur at the same time. Color may be also a symptom of illness or health. For example, the disease of oral thrush affecting the tongue produces a different color than is shown by a healthy tongue.

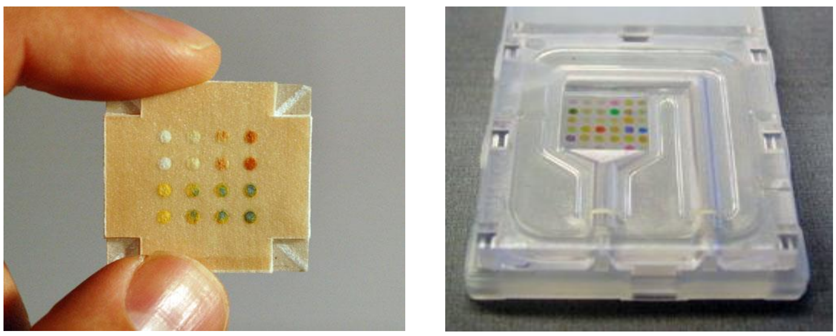
Color works also as an index in genuine synesthesia. If there is a certain neurophysiological mechanism that connects the sensory channels in the case of people having genuine synesthetic experiences, then, we should study this phenomenon inside the sphere of indexicality. This is different from the pseudo-synesthetic associations, which fall in the sphere of iconicity (Caivano, Buera and Schebor 2012: 96). Genuine synesthesia arises as a physical, automatic, and compulsive response to a given stimulus, i.e., an effect produced by a cause. Thus, it consists of indexical relationships.

In a chromatic *metonymy* (a rhetorical figure resorting to indexical relationships), the meanings attributed to the color of an object are transferred to another object, according to a relation of contiguity. Both elements have a certain indexical proximity, which can have and existential or causal origin: a relationship between cause and effect, container and content, a part and the whole, etc. (see Sebeok 1991: 132). The banana juice packaging of Figure 4 exploits a metonymic relationship between container and content. The use of chips of color samples in order to *indicate* the color that we want for an object implies taking a part for the whole, and bears thus an indexical relationship.

Figure 4. Metonymic relationship between container and content: a banana juice packaging (designed by Naoto Fukasawa).

Examples of indexical uses of color can be found also in clinical analysis, which are usually based on colorimetric techniques. Figure 5 shows a device prepared to detect glucose and protein in urine using colorimetric assays (at left), and a colorimetric sensor that uses chemically responsive dyes to detect volatile organic compounds in exhaled breath (at right).

Figure 5. Indexical uses of color in clinical analysis.



Another example of an indexical use of color is related to nutrition, where color is taken as an indicator of the variety of food. There is a sort of "rule" which advices that eating food of five colors is a healthy practice.

- *Yellow* and *orange* foods provide beta-carotene and vitamin C.
- *Green* food has potassium, folate, vitamin C, vitamin K and lutein.
- *Violet* and *purple-blue* foods have anthocyanin and antioxidants.
- *Red* food provides lycopene, anthocyanin and carotenoids.
- *White* food has potassium, magnesium, allicin and fiber.

It must be emphasized, however, that colors are not nutritive by themselves, they work as indicators (i.e., indexical signs) of different nutrients present in food.

Always keeping within the sphere of semantic relationships (relations of signs to objects), we can observe how colors work as indexes of temporal change. This is evident, for example, in the case of leaves in autumn (Figure 6), but is also present in many other physico-chemical processes in which a color change indicates a time span.

Figure 6. Color as an index of temporal change in leaves.

A particular example of an informative function of color can be observed in the Seven colors mountain, in Jujuy, Argentina, where the colors of the different strata are clearly working as indexical signs (Figure 7). A geologist is able to extract plenty of information through the colors of the sedimentary or rocky layers. Here we are in front of an indexical image, because the colors are caused by the same materials and pigments that are being represented by them. The informative function predominates here too:

1. Gray, dark green and violet indicate marine sedimentary rocks, from the Precambrian era (600 million years ago).
2. Purple, dark pink, whitish colors stand for quartzite and sandstones, from the upper Cambrian period (540 million years ago).
3. Light gray to yellow are outcrops of argillaceous sandstones and lutite, from the Ordovician period (505 million years ago).
4. Red nuances correspond to gravels (conglomerates) and sandstones, from the Cretaceous era (144 to 65 million years ago).
5. Reddish to light pink shades are recent sandstones and clay stones, from the Tertiary period (65 to 21 million years ago).

Figure 7. The seven colors mountain, in Jujuy, Argentina.

It is well known that in aerial perspective, color works as an index of distance. In a landscape, objects far away from the observer look bluish and less saturated than near objects. This was a familiar fact for the Renaissance painters, who started using this device to give more realism to their representations. Cesia may also be and index of distance; objects seen in turbid or translucent media provide clues for evaluating distance (Figure 8).

Figure 8. Color and cesia as indexes of distance: aerial perspective (left), a misty forest (right).

Cesia may be also an index of different states of frozen water: solid compact ice looks transparent, ice with bubbles appears translucent, while soft snow shows a matte appearance (Figure 9). In the Artic, cesias are very informative indices. This is what is usually meant when saying that Eskimos have near twenty words for white. Actually, it is not just for white, but for different whitish appearances involving cesia.

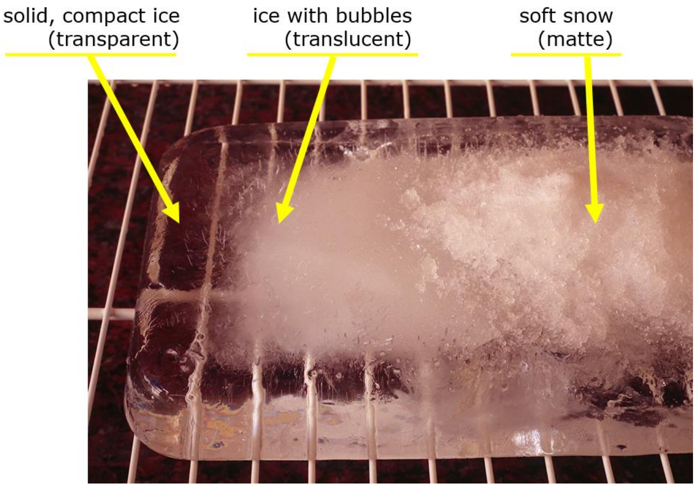


Figure 9. Different appearances or cesias in frozen water.

Cesia works as an index in liquid foods. For example, milk diluted with water looks translucent, while pure milk is white and more opaque.

Color and cesia together work as indexes in food. A crunchy, juicy red delicious apple has a glossy cesia and a saturated red color, but a mealy and dry apple usually appears with a matte cesia and a non saturated color (Figure 10).

Figure 10. Color and cesia as indexes of food quality.

The following example was already mentioned in a previous publication (Caivano 1998: 397):

> The color purple illustrates a case of an index transformed into symbol. In the past, when purple was very difficult and expensive to obtain, it was the color of royalty. In the Roman Empire, only senators, victorious generals, and the emperor himself were allowed to wear purple. Today, this indexical connection has disappeared, but purple still conveys meanings of magnificence, pomp, dignity, nobility, and elevated position. In Spanish, the cardinals' rank in the Roman Catholic Church is still referred to as *purpurado*. The general rule that can be verified is that the repertoire of symbols in a culture grows at the expense of other types of signs, for instance iconic and indexical signs (Peirce 1860-1908 [1931-1935: 2.302], Short 1988). In other words, a sign that in a certain context begins to be taken as an *icon* (because of a relationship of similarity between it and what it represents), or as an *index* (because of a physical connection between it and its object), with time and with its reiterative use becomes a *symbol*, because habit causes the relationship to be preserved in an arbitrary way, independently of the original connection.

Based on the triadic peircean model of semiotics, developed as a semiotic nonagon, Guerri and Huff (2006: 196-197) present a logical and exhaustive classification of indexical functions of color within the semantic categories. The main three headings of the classification of color indexes, from which subsequent triads are derived, take into account: 1) color within the parameters of physics, chemistry and physiology, 2) color as a symptomatic property, and 3) color in relation to its material performance. In this sense, all the examples analyzed so far in the present paper can have a logical place in this developed triadic model.

Indexes in Non-Human Realms

For the previous examples, we have resorted to indexical semiosis of color and cesia in the form of signs originated either in culture or nature, but always interpreted by human beings, i.e., cultural semiotics, or anthroposemiotics. Now, let's go beyond this, and pose the following questions:

● Can semiotic phenomena involving color and cesia (and in particular of the indexical type) be present in other realms of the biological world, such as in other animal species and even in plants?

● Could these processes be extended even beyond, to other realms of nature, the ones that are usually classified as the abiotic or inert world?

We are referring here to signs originated in nature and interpreted by organisms or systems outside the human realm. Let’s analyze first some examples from the animal kingdom.

There is a symbiotic relationship between bees and flowers: bees seek pollen for food, while flowers benefit from unintentional pollination made by bees. Certainly, symbiosis is also a semiotic process. It is defined as a close and often long-term interaction between different biological species. Thus, symbiosis involves communication and exchange of information in the form of an indexical relationship. Flowers send visual signals to bees, in the form of reflecting ultraviolet radiation, that humans are unable to see. Figure 11 shows how a flower appears to human vision as compared to bee vision. ¿How flowers send visual signals to bees? In this example, human vision perceives one color, while bee vision detects two colors, which allow to differentiate more clearly the parts of the flower, and attract as a target.

Figure 11. A flower as seen by a human being (left) and a bee (right). (Bjorn Roslett Science Photo Library)

Colors are signals for mating in birds and other animals. Jack Hailman (1997: 280-300) develops this issue in some extent. The importance of color as an indicator for successful mating is emphasized in the following paragraph:

> The two major requirements for a potential mate are that it be of the same species and the opposite sex ... Mating with another species wastes time and gametes because such mating often produce no offspring ...
> The necessity for correct attraction of potential mates has often been used to explain dramatic differences in display coloration between male and female, and among males of different species. (Hailman 1997: 280)

Animals may also exhibit deceiving behaviors by using color indexes. Figure 12 shows a venomous coral snake, at left, and a harmless red milk snake that mimics the bright colors of the venomous coral snake, at right. “Deception in animals is the transmission of misinformation by one animal to another, of the same or different species, in a way that propagates beliefs that are not true. Deception in animals does not automatically imply a conscious act, but can occur at different levels of cognitive ability” (Wikipedia 2014).

Figure 12. Deceiving behavior by means of color. A venomous coral snake (left), and a harmless red milk snake (right).

Finally, let's reflect about color semiosis and indexical activity in what is called the abiotic or inert world. First, I would like to call into question the notion that the abiotic world is completely inert. A planet that orbits a star, is really an inert or inanimate object? (We should remember that the meaning of "animate" is related to motion). A star (or our sun) is also inanimate? There are certain internal or external forces moving these objects. If these forces (e.g. gravity) are internal to the star or planet, can it be called an inanimate object? If our Earth is inanimate, how to explain the tectonic movements, volcanic activity, wind, tides, etc.?

As a matter of fact, biological activity, life, was possible because the Earth (with the solar system) provided the necessary elements. It was the Earth that gave origin to life. Thus, since life is a semiotic process, semiosis must be also present in the elements that preceded and allowed life. Additionally, we can emphasize that the traditional divisions or frontiers between living and nonliving systems, between animals / plants and minerals, are fading from year to year, as Georges Deflandre already pointed out in 1956 in his book entitled *Life, creating rocks* (Deflandre 1956 [1977: 5]).

The same book by Deflandre explains how sedimentary rocks have been built, in fact, by billions of microscopic organisms (animals, plants, protists), glued together. That is to say, what we usually consider minerals have been originated by former living organisms, and the transformation that allowed this process still continues. Having said this, we can notice that even "inert" materials can interact and produce physical and chemical exchanges among them.

One of the many examples of interaction between elements considered outside the biological world is a process that involves minerals and luminous radiation: the phenomenon of mineral fluorescence. This is a kind of interchange by which some minerals receiving radiation in a certain range of wavelengths (for instance, ultraviolet radiation) are able to temporarily absorb a small amount of this radiation and, an instant later, release it in a different wavelength (for instance, within the range that is visible to humans).

In this case, UV radiation (short wavelength) has the ability to excite electrons within the atomic structure of the mineral. "These excited electrons temporarily jump up to a higher orbital within the mineral's atomic structure. When those electrons fall back down to their original orbital a small amount of energy is released" in the form of longer wavelength radiation (King c.2013).

This process of action and reaction is already an elementary kind of semiosis, certainly of indexical nature, involving an exchange between nonliving entities, such as light and minerals.

Conclusion

Semiotics, and particularly visual and color semiotics, is not only concerned with signs that depend on culture; it includes sign processes both in culture and in nature. Indexical semiosis, i.e., semiotic processes involving the kind of signs characterized as indexes, can be taken at the basis of the building of visual semiotics, independently of verbal semiotics. Juan Magariños de Morentin (2007: section II.28) refers to the fallacy that implies the reference to the model of speech when trying to build a model for visual semiotics. He says that this fallacy has stopped and distorted the development of a semiotics of visual images, particularly because it has slowed the emergence and development of an indexical semiotics.

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J. Caivano, SICyT-FADU-UBA, Ciudad Universitaria Pab. 3 piso 4, 1428 Buenos Aires, Argentina
E-mail: caivano@fadu.uba.ar