The Representation of the Visual World in Photography

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Abstract

As a visual sign, a photographic image usually represents an object or a scene; this is the habitual way of seeing it. But it accomplishes that common semiotic task by representing various formal features of the object or scene: its color, shape, texture and spatial distribution of light. The curious fact is that photography does this in very different ways. With respect to color, a pigmented object produces a certain spectral distribution of light, and an ordinary photograph of that object causes approximately the same spectral distribution. The pigmented emulsions of the photographic paper act upon light in the same way as the pigmentation of the objects. In this sense, photography represents color by sharing physical properties with the objects. In truth, instead of representing color, it reproduces color. We have an indexical aspect of photography here (an index being a sign that is physically connected to the object that it represents). This is quite different from what occurs with the representation of the spatial distributions of light (transparency, translucency, mirror-like appearance, gloss, matt quality, etc.) by photography. A glass of water is a physically transparent object that generates the visual sensation of transparency, but a photograph of that glass, being an opaque object in itself (the substratum is an opaque piece of paper), also conveys the sensation of transparency. Summing up, photography represents the spatial distributions of light not by sharing physical features with the objects, but by means of a transformation that brings about a certain kind of similarity. In this sense, we could speak of iconicity (an icon being a sign that refers to its object by means of some kind of similarity with it). This paper will present a survey of these and other semiotic categories involved in photography when representing color and the perceived spatial distributions of light.

Introduction

As a visual sign, a photograph usually represents an object or a scene; this is the habitual way of seeing it. But it accomplishes that common semiotic task by representing various formal features of the object or scene: its color, shape, texture, spatial distribution of light, or even its eventual movement. The curious fact is that photography does this in very different ways.

Our visual world is made of light, because the only thing that our visual system can sense is a certain portion of radiation that gives origin to the perception of light. Light or, more properly speaking, visible radiation is also the physical agent for photography. But our visual system —which comprises all the mechanisms between the eye and the visual cortex— constructs other categories by means of light patterns. These visual categories are usually classified in four or, better, in five groups:

1) *Color*, that is, the perception of the different spectral compositions and intensities of visible radiation;

2) *Cesia*, a new category that describes the sensations originated by different distributions of light in space, producing the perception of transparency, translucency, opacity, mirror-like appearance, matt quality, etc.;

3) *Shape*, that is, the construction of different spatial configurations starting from the detection of borders between areas differing in color or cesia;

4) *Texture*, that is, the construction of patterns made of relatively small elements (also detected by differences in color or cesia) that are visually grouped according to certain features;

5) *Movement*, which implies the perception of displacement of areas or visual elements, either between themselves or all of them with respect to the observer.

It has been argued whether photography functions as an indexical sign, because of its necessary physical contact with the objects that emit, reflect or transmit the light patterns that the photograph fixes, or as an iconic sign, because of its condition of being an analogical representation of the visual world (see, for instance, [1-5]).

The present paper analyzes how the visual categories described before are reproduced by photography or represented in it. We will see that the consideration of a photograph as an index, an icon, or even a symbol, depends largely on which visual category we are taking into account at each moment.

As a conceptual frame of reference, let's introduce the basic definitions of icon, index, and symbol. An icon is a sign that is related to the represented object on the basis of a certain similarity or some common feature, which may be a similarity of shape, color, etc. An index is a sign that has a physical relationship with the represented object; i.e., a physical co-presence of index and the represented object is required, and the connection between both is immediate. A symbol is a sign that has an arbitrary relationship with the represented object; it works by means of a codification; i.e., the knowledge of the code is required to be able to grasp the meaning of a symbol, and the decodification implies a certain timescale of cognitive processing.

Color: the representation of the spectral distribution of light

With respect to color, a pigmented object produces a certain spectral distribution of light, as a consequence of a selective absorption of the received radiation within the visible range; and an ordinary photograph of that object produces approximately the same spectral distribution, to the extent that if the radiation reflected both by the object and by the photograph are measured, the two resulting curves are very similar or practically identical (inasmuch as the photograph has good color reproduction). In other words, an object that looks red in our external world is represented by a red area in the picture (we are dealing here with the common color photography, in which no filters or special shifts of color are employed). The pigmented emulsions and layers of the photographic paper act upon light more or less in the same way than the pigmentation of the objects does (Figure 1).

In this sense, photography represents color by sharing physical properties with the objects. In truth, instead of

representing color we can say that a photograph reproduces color. Thus, we have an indexical aspect of photography here, according to the definition of index we have seen.

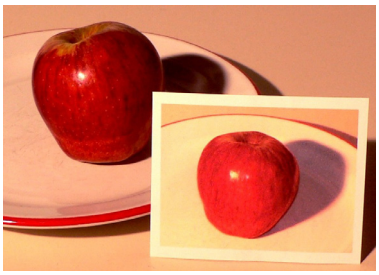


Figure 1. *A pigmented object and a photograph of it.*

Cesia: the representation of the spatial distribution of light

Light interacts with objects and it can be absorbed, reflected or transmitted, either regularly, mainly in one direction, or diffusely, in all directions. These are physical matters that the human visual system perceive, decode and interpret as visual signs carrying information about certain qualities of the objects around: level of lightness or darkness, degree of opacity, gloss, transparency, translucency, matt quality, etc. These visual aspects have been encompassed under the generic term "cesia" [6-8].

Photography represents the spatial distributions of light or cesias (transparency, translucency, mirror-like appearance, gloss, matt quality, etc.) in a quite different way than it represents color. Putting it in simple terms, both the visual perception of an object and the photograph of that object have necessarily the same color, but not necessarily the same cesia. Let us see a very common fact: a glass of water is a physically transparent object (it allows the regular transmission of light) that generates the visual sensation of transparency; but a photograph of that glass, being an opaque object in itself (the substratum is an opaque piece of paper that hardly lets the light come through), also conveys the sensation of transparency (Figure 2). Similar situations occur in the reproduction of other types of cesia, that is, translucency, mirror-like appearance, gloss, matt quality, etc. In a slide (a film slide), which is a transparent object in itself, there may be perfectly represented a mountain, which is an opaque object.

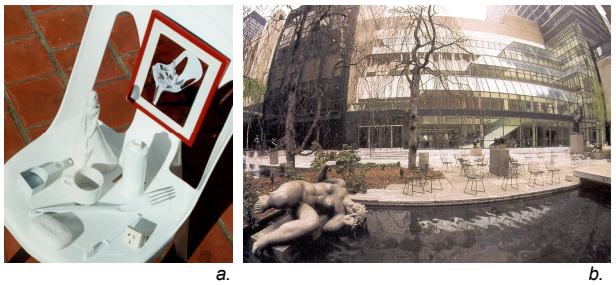
Summing up, photography can represent the spatial distributions of light without sharing physical features with the represented objects —in this case, the photo and the object are two different physical realities—, instead, it produces a transformation that brings about a certain kind of similarity between sign and object. In this sense, we could speak of iconicity in the photographic representation of cesias.

Figure 2. *A transparent object and a photograph of it.*

Shape: the spatial configuration of the visual world

With respect to shape, or spatial configuration, it happens that a photograph, which is a two-dimensional piece of paper or display, adequately represents three-dimensional objects, in the same way than a drawn perspective does (Figure 3a). Nevertheless, there are big differences between the perception of shapes and space by our visual system and the reproduction of them by photography.

First of all, human beings have binocular stereoscopic vision, while photography is equivalent to the point of view of a single eye, a kind of cyclopean vision. Furthermore, the photograph can present images that, compared with the ones obtained by our direct vision, result considerably distorted (as it happens with the shoots made with wide-angle and fish-eye lenses), and even so the objects result perfectly recognizable (Figure 3b). Another alteration that photography normally produces, and that is usually neglected because of its obviousness, is the change of size: the images of the objects in the photo may be smaller or bigger than the images of direct vision. In long-shoot pictures they are usually smaller, with the use of macro lenses it is the opposite way.



a. *b.*

Figure 3. *a) Objects of different shapes and a photograph of them, with a smaller size. b) A wide-angle shot: right lines appear curved.*

Thus, with respect to shapes and space, iconicity in photography does work, because the recognition of what the photo represents is given by a transformation of a topological kind. Shapes and spaces in the photographic image and in direct vision are only similar.

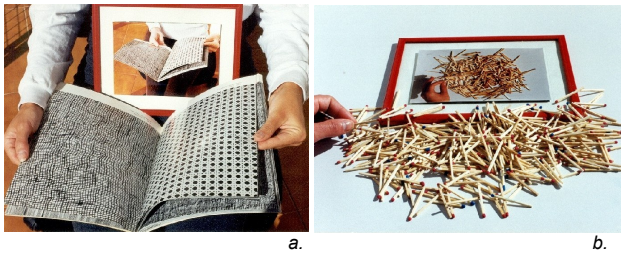
Texture: the visual patterns composed of small elements

We have seen that the representation of the spatial distribution of light (or cesia) in photography is not physically congruent with the spatial distribution of light produced by the photographed objects themselves, and that the geometrical status of photography is different from the geometry involved in our visual world.

Texture is a phenomenon that can be considered as something of a visual nature and also of a tactile nature. Let us concentrate on the visual aspect. If we take a texture that is devoid of relief, something like a drawn texture, only perceptible by vision, then, a photograph gives a very close reproduction of it. Picture and textured object are in the same geometric space, and both the perception of the texture and the reproduction made by the photograph work because of differences in luminosity or color between the elements and the background. Thus, we come back to the indexical aspect of photography (Figure 4a).

But if we take a texture that has relief, that is materialized in a three-dimensional space, which in addition of being perceived by vision is perceived by touch, then, photography

faces the same constraints than it has for the representation of shape and the qualities of space. And we return to the iconic aspect (Figure 4b).



a. b.

Figure 4. *a) Two-dimensional (visual) textures and a photograph of them. b) A three-dimensional (visual and tactile) texture and its picture.*

Movement: the visual perception of the displacement of objects

With respect to movement, photography, being precisely the fixation of an instant and hence carrying the feature of immobility, has to resort to certain basic devices or conventions to represent it. In this sense, and against the claims of Roland Barthes [9], who had considered photography as a message without codes, we have the fact that certain elementary codes are necessary to interpret the representation of movement in the photographic image.

There are various ways of representing movement by photographic techniques. One of them is by means of an effect of blurring or sweeping. This blurring of the image may occur in different ways:

1) The moving object is presented as a blur and the background appears fixed, which is obtained by means of a steady camera and a relatively long exposure time (Figure 5a).

2) The moving object appears fixed and the blurring is given in the background, which despite of seeming a contradiction results in a very effective representation of movement, very often used in pictures of car races or sports (Figure 5b).

3) Both figure and background appear blurred or "moved", as it often happens to an inexpert photographer when his camera moves while he is taking a shot, but what may result in interesting artistic effects when made purposely (Figure 5c).

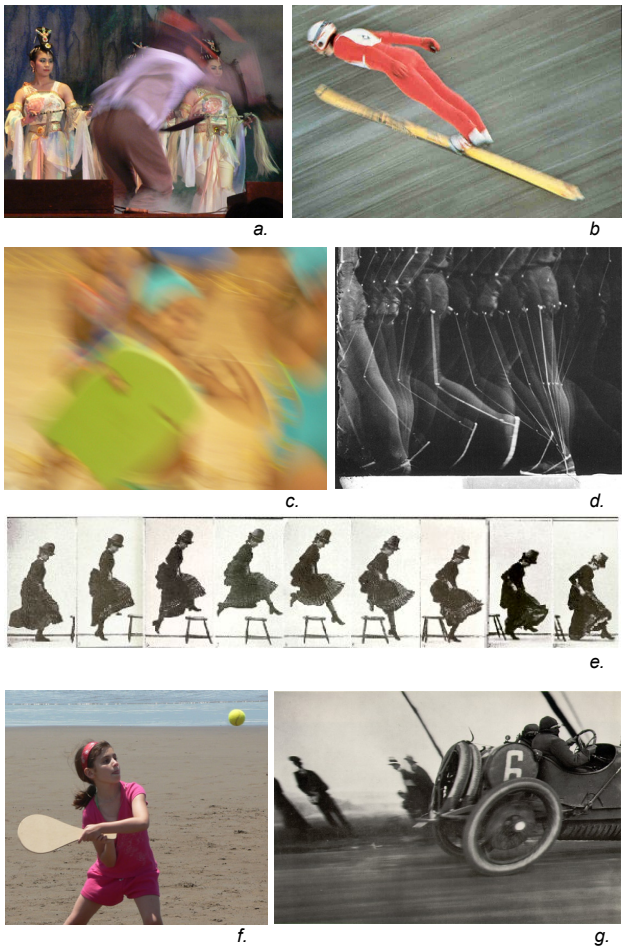
Some other techniques, instead, do not resort to the blurring of the image:

4) The movement may also be represented by a sequence of fixed images isolated in the same photograph, as with the shots taken with stroboscopic light or with blinking flashes, such as in the photographs by Marey (Figure 5d), or by a sequence of fixed photographs, such as in the famous sequences by Muybridge (Figure 5e).

5) Movement can also be represented in a photograph where the object has been "frozen" in a unstable position, that our knowledge of the visual world must resolve in the instant before and the instant after, as in the picture of a dancer while he is jumping on the air or in photographs of sports taken with a very short time of exposure (Figure 5f).

6) Finally, a very special case, studied by Arlindo Machado, is the representation of movement through anamorphosis in photography, an effect that can be obtained by "using a focal plane shutter or a 'wipe' shutter, *i.e.* a shutter which 'scans' the frame of the camera at successive intervals, exposing each part of the film at different time intervals" [10]. Thus, the moving objects appear distorted, as if they were "stretched" in the direction of the displacement. Figure 5g is a famous photograph took in 1912 by Jacques-Henri Lartigue during the Grand Prix of France.

There exist, of course, various differences between most of these ways of representing movement in photography and our direct visual perception of movement. I am not going to enter into details, but it is obvious that in some of the mentioned cases the photo resorts to certain canons or conventions, also used in painting and sculpture to represent movement. And, in this sense, thus, the symbolic aspect of photography appears.



a. b. c. d. e. f. g.

Figure 5. *Different representations of movement in photography. a) Moving subject and steady background. b) Fixed subject and blurred background (Haas). c) Both subject and background are moved. d) A sequence of images in the same photograph (Marey). e) A sequence of fixed photographs (Muybridge). f) A scene frozen in an unstable position. g) Anamorphosis produced by movement in photography (Lartigue).*

Photography as a complex message

From what has been said, it seems that it is pertinent to consider photography as a complex kind of visual message, such as it is considered by Schaeffer [5], *i.e.*, a message that cannot be included or classified into a specific kind of sign. We have seen that different photographs may work as different types of signs. And even, we have seen that different aspects of the same photograph may also function as different types of signs.

When the iconic status of photography is defended because it constitutes an analogical reproduction of the world outside, this is claimed by referring to the representation of

shapes and space in the photo in geometric terms. When, on the contrary, the indexical status of photography is defended, this is claimed by referring to the way color is reproduced by the photograph. Perhaps the main ingredient that has nourished this controversy is the fact that such contextual differences have not been analyzed consciously.

Post-photography, or digital manipulation of photography

In the recent years, digital technologies have begun to be used in at least two ways: on one hand, for the manipulation and modification of photographs taken in the traditional fashion, while on the other hand, for the creation of images with photographic appearance but without employing the photographic technique. This last may be the case of the representation of nonexistent objects (Figure 6). Because a referent, an object whose light has impregnated the substratum, is lacking, we could not properly speak of photography. The name *post-photography* has been suggested for this new product. Let us see what formal features it shares with traditional photography and on which aspects it relies to emulate photography.

Figure 6. *Quasi-photographic image produced by digital means, without employing photography (Diego Caivano).*

One of the visual elements that a photograph represents with greater realistic appearance than any other representational device (such as drawing or painting) is the spatial distribution of light that the objects produce, their cesia. These kind of visual signs, along with signs of shape and texture, are the ones that give "realism" to a perceived image. In this respect, these signs are more important than color, because black and white photographs are considered more "realistic" representations of objects than colored paintings, even of the naturalistic or realistic school, for instance.

As we have seen, photography reproduces color in a much more "realistic" way than it reproduces any other kind of visual signs, because the external objects and the photographic reproduction of them share the same physical properties with respect to the spectral distribution of light that originates color perception. However, color is not the most important aspect to give realism to a photograph. We can note a kind of contradiction here: While color is the visual sign that is reproduced by photography more closely to the way it appears on objects, in the sense that the process is related to the physical reality of objects, color is the sign that less contribute to the appearance of realism and concordance with the physical reality that photography conveys. Instead, this role is endorsed to other visual signs of photography, mostly to perceived spatial distribution of light and texture.

One of the consequences of this is that post-photography —understood as digitally produced or modified images with photographic results—, must rely more in these kind of visual signs than in any other one if "realistic" images are intended. The important thing is to make correct representations of spatial distribution of light and texture, color and shape are less important (Figure 7). In this sense, it can be verified that the aspect that has made the softwares of drawing's rendering or photographic processing to evolve notably is the manipulation of devices for the simulation of spatial light distributions and surface textures.

Figure 7. *Digitally produced or modified images with photographic results (Matrix).*

Differences between traditional photography and post-photography

Let us consider different phases of semiosis in the photographic process:

1) First, we have visible radiation emitted by some source, for instance, in shots taken in sunlight, the sun. This radiation hits upon an object (let's suppose, a flower), which absorbs a part of it and reflects or transmits the remaining radiation. The photographic camera, focused on that object, captures in turn a part of that reflected or transmitted radiation —only the part that is reflected or transmitted towards the direction of the lenses, the remaining part being "lost" (at least for the camera) in other directions. This is precisely what makes the photographic image to provide a single point of view of a steady object, while a cinematographic image or a video, where time is present, allows to circumvallate the object, capturing the radiation reflected or transmitted by the object in multiple directions, and bringing for this reason a succession of many points of view. Only when the object moves has photography some possibilities of yielding more than one point of view of it. For instance, a shot with a relatively long time of exposure will allow to capture a rotating or moving object in all its facets. Some of these possibilities are developed by Machado when he analyzes the images that can be obtained when the time factor is introduced in photography [10].

Up to this point, however, we have a series of purely physical contiguities, and the dominating feature is indexicality (Figure 8). In this phase of the process there are no important differences between traditional photography and digital photography.

2) In the second phase of the process, the radiation entering trough the lenses of the camera is fixed and stored. Here, the main difference between traditional photography, which is an analogical process, and digital photography appears. The light pattern that hits upon the emulsion of the film in the traditional camera produces a negative *analogon*. In a digital camera, the same pattern of light is codified into an algorithm, which has no relation of similarity or congruence with the physical event that originated it. To the camera, which at this stage of the process is the agent that produces the *interpretant* sign (the sign providing an interpretation), the

pattern of light is the *representamen* (or sign proper) of the *object*. But this representamen is interpreted differently by a traditional camera or by a digital camera.

3) At the third phase another transformation takes place. In the traditional photographic process we go from the negative to the enlarged positive image through a series of physical contiguities where congruencies are present. In the digital photograph we go from the abstract algorithm to the referential image by means of a decodification. Once this conversion is made, we see no practical difference between the traditional photograph and the digital one (except that a notorious "pixelation" exists in the digital image).

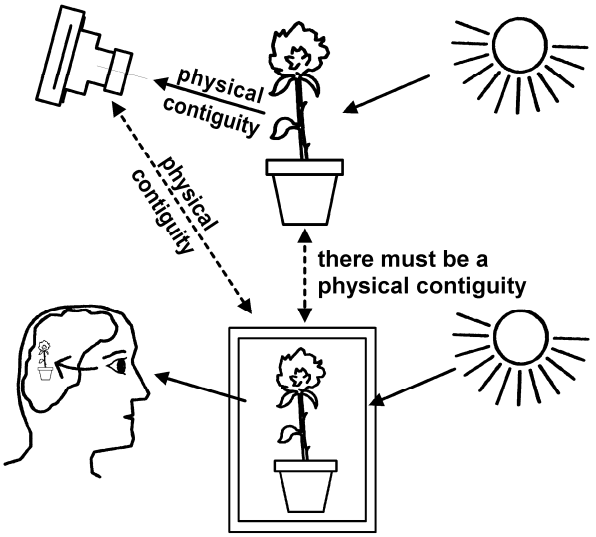


Figure 8. *Series of physical contiguities in photography.*

4) Finally, a human observer (in most of cases) receives through his eyes the radiation that is now reflected by the enlarged positive picture, which is analogous to the radiation reflected before by the object in the direction of the camera (Figure 8). In traditional photography this connection was never lost, as if it consisted of a succession of imprinted transfers. In digital photography, however, there was an intermediate process of codification and decodification. What follows now, until the human observer interprets that what the picture represents is a flower (the flower that we used as example), is a much more complex process, and little is known about what happens in the last stages of it. Between the retina and the visual cortex there is, no doubt, an intricate series of codifications and decodifications. But whether we are looking at a traditional photograph or a digital one, there is no substantial difference in this process.

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