Visual texture as a semiotic system

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Texture, design, semiotics

What place does the study of visual texture occupy in the field of design? Considered in its different modalities (architectural, graphic, industrial), design is a discipline which involves various semiotic systems. On one hand, it includes systems of representation, such as perspective (in its variants: conic or axonometric) and Monge's system of descriptive geometry. On the other hand, it comprehends systems of prefiguration of pure design. If we are able to draw a quadrangular room in a plan (a representation), it is because we have previously had the form 'square' (a pure form) as a possibility. These systems of pure design refer to the formal structures which are behind a visual representation.

We recognize, according to Jannello (1988), four systems which allow us to analyze any representation or visual perception. They are the theories of Spatial Delimitation (or Form), Color, Texture, and Cesia. Therefore, Visual Texture is one of these systems, standing at the same theoretical level.

Can visual texture be considered a semiotic system? The affirmative answer will imply primarily that in referring to it, we are dealing with signs.

As Peirce states, a sign 'is something which stands to somebody, for something, in some respect or capacity' (CP 2.228). With this simple definition Peirce constructs the three aspects of the sign. He also argues that all our knowledge and thought is necessarily in signs (CP 5.251). This affirmation is enough to assume that visual textures are signs. But how do they fulfill the three requisites? Paraphrasing Peirce: when an observer sees a texture, it produces equivalent signs or interpretants in his mind (signs of other characteristics — e.g., tactile concepts such as rough, smooth, etc.). The texture stands for an object (perhaps for the physical composition of a material). It has such internal relations that we can recognize it as belonging to the same kind of texture, even if it appears at different times or on different materials (it has a specific form) (CP 2.228).
We also have to demonstrate that visual texture can be developed following the three branches of the science of semiotics — i.e., that it is possible to construct rules for the relation of the textures among themselves, for the relation between the textures as signs and the objects to which they refer, and for the relation between the textures and their interpretants.\(^3\) The first aspect will be developed as the central part of this article; for the other two aspects we will make some suggestions, leaving their development for further investigations.

**Antecedents**

Texture, in its visual aspect, is a subject which has scarcely been studied, to such a point that to compile a bibliography about the theme constitutes an investigation in itself. Even among the works found, only a few approach this field in a systematic way.

Some authors do not seem to take texture into account. Pope (in Pope et al. 1974: 95), for example, writing about visual perception, says: ‘We may define the visual image by defining the position, the size, the shape, and the color of each of its areas’ (no mention of texture). Others have written about texture as perception, but without making a deep analysis of it. Gibson defines the sensation of texture produced by the surface of a given material:

In either event, whether the reflecting particles are structural or chemical or both, they will reflect light differentially and the image of the surface will consist in an array of cyclical changes in light energy which we experience as variations in brightness or hue. . . . These cycles, we suppose, constitute the stimulus for visual texture. (1950: 80)

This definition seems good enough at first glance, but then Gibson limits his observations to consider texture only as a phenomenon that may vary from coarse to fine, calling this a variation of density. This is not a completely bad definition, but if we go deeper into the study of texture, we will find it insufficient. It leaves out of consideration other aspects that may characterize a texture.

Jannello (1963: 394) analyzes ‘the appearance of objects in the visual world’ as composed of three fundamental ‘perceptive manners: form, color, and texture’.\(^4\) He defines texture as:

a perceptive phenomenon founded in the existence of small elements that, juxtaposed in groups, compose entities (which may be lineal, superficial, or
volumetric). The extension of these small elements is much smaller than that of the entities composed by them. The small elements produce a close heterogeneous stimulation which has the virtue of making perception possible, even when the borders or limits of the entities are derived from the visual camp. (1963: 394)

He also sets the limits for what should be considered a textured or a subdivided surface, by means of the relation between the size of the analyzed surface and the size of each unity of texture (Fig. 1).

Going beyond other authors, Jannello classifies textures into purely visual (two-dimensional or flat textures), rugged or deep (laminated textures or ‘nets’), and spatially textured bodies (corporeal textures or ‘reticles’). He concurs with Gibson’s definition, affirming that ‘the heterogeneity of flat surfaces is founded in tonal differences (colour, luminosity, saturation)’ (1963: 394). But he makes a more exhaustive analysis of the variations of texture, establishing that textures can vary in three ways or modalities: directionality, size, and density. These three ‘dimensions’ are nevertheless described a bit diffusely by Jannello, without specification of their variation in quantitative terms.

**Classification of textures**

First, I consider that the taxonomy of three kinds of textures (flat, laminated, and corporeal) is not absolutely necessary, other than for a rough description of certain texture. In limiting cases, we could not say whether a texture is flat or laminated, laminated or corporeal. Where are their limits? It is very difficult to establish them. It is better to think that a texture can vary from plane (purely visual) to volumetric (visual and tactile) in a continuous way, by increasing its depth from zero to infinite, in order to include all the examples: from the textures drawn on a sheet of paper to the texture of cosmic space.

![Figure 1](image)

*Figure 1. Limits for the consideration of texture: (a) textured surface; (b) subdivided surface (from Jannello 1963: 394). Reprinted courtesy of Architectural Design Magazine.*
It is important, on the other hand, to consider a classification which refers to the reduction of texture for analysis. Textures can be metrical or a-metrical, the first being those textures that are measurable in any way (generally artificial textures, such as the texture of a piece of cloth); and the second, those that are not exactly measurable (generally natural textures, such as the texture of a piece of wood).\textsuperscript{5} The only way of analyzing a-metrical textures with accuracy is to reduce or transform them into metrical patterns. However, we can also compare a-metrical textures in a broad sense and without reducing them, by means of the three previously mentioned dimensions (directionality, size, and density). Metrical textures are subdivided, according to their complexity, into simple textures and configurations of texture. All metrical textures which cannot be exactly described through these three dimensions will be considered to be configurations — i.e., complex textures formed by superposition of various simple textures (Fig. 2).

All these kinds of textures, on the other hand, have another possibility: they can be plane or volumetric. The perception of plane textures depends purely on differences of color (hue, clarity, or chromaticity) between the repetitive elements which compose them and the background. Because

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\caption{(a) metrical}
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\caption{(b) a-metrical}
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\includegraphics[width=\textwidth]{fig2c.png}
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\begin{subfigure}{0.25\textwidth}
\includegraphics[width=\textwidth]{fig2d.png}
\caption{(d) complex}
\end{subfigure}
\caption{Classification of textures: (a) metrical; (b) a-metrical; (c) simple; (d) complex (textures reproduced from Hornung 1976).}
\end{figure}
they are completely flat, the direction and angle of incidence of light does not have any consequence on plane textures. In the perception of volumetric textures, in addition to their own depth, the variation of direction or angle of incidence of light may have great importance. A light directed perpendicularly produces the sensation of diminishing the depth, while an oblique light produces the sensation of increasing it.

I am going to consider only the simple and plane textures for the moment. This study constitutes the logical first step for the study of volumetric textures as well. It will be necessary for the description of complex textures, the development of a system according to which the combination of simple textures could be analyzed.

Simple textures are formed by repetition and juxtaposition of a minimal unity called *unity of texture*. It is composed of a pair of *texturing elements* and their respective intervals. It is considered the texturing element, coinciding with Jannello’s definition (1963: 395), ‘the narrowest or thinnest part’ that composes a texture. Thus, in the texture of a brick wall, for example, the texturing elements are not the bricks but the joints between them⁶ (Fig. 3).

**Dimensions of texture**

Having defined these points, we can redefine more exactly the three dimensions of texture. I will conserve the names that Jannello gave them, because the general sense is maintained. But it is necessary to say that their concepts change in certain aspects because of the fact that the definitions are based on the precedent considerations. The dimensions are:

(a) Directionality, which is the dimension that depends on the proportionality of the unities of texture. It is measured by the division between length and width of the unity of texture. The directionality varies between two opposite poles: the a-directional textures (directionality = length/
width of unity of texture = 1), and the lineal textures (directionality = length/width of unity of texture = \( \infty \)). When we compare various textures we can speak about constancy or variation of directionality, whether it be that all of them have the same, or different directionality (Fig. 4).

(b) Size, which is the dimension that depends on the surface of the texturing elements. The size varies from a big surface to a point (size = 0). Comparing various textures, we say that there is constancy of size among them if their respective texturing elements have the same surface; and there is variation of size in the opposite case (Fig. 5).

(c) Density, which is the dimension that depends on the relation between the texturing elements and the background. Normally, we refer to density by saying that one texture is sparser or denser than another. The density is measured within a unity of texture, by the division between the surface of the two texturing elements and the surface of the background (excluding from it the surface of the texturing elements). The density varies between two opposite poles: the textures of maximum density (density = surface of texturing elements/surface of background = 1) and those in which the sensation of texture disappears because the texturing elements are not perceptible over the background (density = surface of texturing elements/surface of background = 0). When we compare various textures we say that the density is constant if all of them have the same relation between texturing elements and background; in the contrary case we say that the density is variable (Fig. 6).

By means of these three dimensions we can describe exactly any plane simple texture.

![Figure 4. Variation of directionality.](image)

![Figure 5. Variation of size.](image)
**Paradigm of texture**

These three dimensions also allow us to organize systematically the whole conjunct of plane simple textures in a solid of texture, as has been done for color by various authors. We call this structure *paradigm*, incorporating for texture the terminology used by Jannello (1988) for Spatial Delimitation. The paradigm can be considered as a kind of ‘dictionary’ of elements — in our case, of simple textures. It is structured through the above mentioned dimensions of texture. Each dimension varies in a continuity according to one distinct succession of planes within the paradigm.

The textures with constant directionality are arranged in triangular planes as shown in Figure 7. In Figure 7a we can observe the textures with constant directionality = 1, and in Figure 7b, the textures with constant directionality = 4. These two planes are only two examples of the infinite quantity of different directionals we can have.

While the directionality is maintained the same in the whole plane, the size and density vary. In these planes of constant directionality, the textures of constant size are arranged according to parallel lines as shown in Figure 8a; the textures of constant density are arranged according to lines converging on the vertex of the triangular plane (Fig. 8b). Each line of constancy passes through the center of the chips of texture having that constancy.

![Figure 6. Variation of density.](image)

![Figure 7. Paradigm of texture (partial): (a) plane of constant directionality = 1; (b) plane of constant directionality = 4.](image)
In these representations it is necessary to draw the textures in a discrete way. From the center of a chip to the center of the next one there is a separation, so the textures exemplified vary step-by-step. But the structure of the paradigm was made in such a manner that it is possible to draw a chip of texture at each of the infinite points of the paradigm: in this sense, the variation is continuous. On the other hand, the representation of the paradigm was interrupted at a certain size, but it can grow without limits in the directions indicated by the dotted lines.

The general paradigm is developed by means of the sequence of constant directionality planes (from 1 to $\infty$). They are attached to a common axis, which is constituted by the textures of density and size = 0 (Fig. 9a). If we consider the lines of constant size along the succession of all the planes of directionality, the result is a plane of constant size for all the textures. Figure 9b shows various planes (from 0 to a certain size), each one of constant size, in the general paradigm. If we consider the lines of constant density along the succession of all the planes of directionality, the result is a plane of constant density for all the textures. Figure 9c shows various planes (from 0 to 1), each one of constant density, in the general paradigm.
Harmonies of texture

Through the dimensions and the paradigm, it is possible to make selections of textures according to certain logical principles of harmony. Considering for each dimension the binary possibility of constancy (+) or variation (−), we can construct a matrix of relations as exemplified in Figure 10.

First, we consider the possibility of the constancy of the three dimensions (case 1). Following this formula, we have to select textures of the same directionality, size, and density. In this case we are in the presence of a repertory of identical textures. As each texture occupies a point in the paradigm, this selection is made at one and the same point (the intersection of the three planes of constancy).

Second, we can consider the possibility of having two constant dimensions and one variable dimension (cases 2, 3, 4). The selection of textures is made according to lines (the intersection of two planes of constancy) in the paradigm.

Third, we have one constant dimension and two variable dimensions (cases 5, 6, 7). The selection of textures is made in conformity with surfaces (the corresponding planes of constancy) in the paradigm.

Finally, we consider the possibility of all three dimensions being variable (case 8). The selection of textures is made in the whole paradigmatic body.

We have, thus, a sequence of formulas to select textures, going from absolute constancy (‘monotony’) to the maximum possible variability (apparent ‘chaos’). The expression of variability in relative rather than absolute terms, and the expression ‘apparent chaos’, are because I believe it is always possible to describe some organization, even if it is very complicated. As D. Bohm notes, ‘there is no such thing as “disorder”, if this term is meant to indicate a total absence of order of any kind whatsoever. For whenever anything happens, it evidently occurs in some kind of order ...’ (1968: 140). In this sense, the paradigm gives us another chance of making harmonic selections. If we select textures placed at distances based on a certain rule (arithmetic or geometric progressions, or other organizations) within the paradigm, we will obtain a variation of textures which will follow that rule; so, we will have a certain degree of constancy in the variation. The constant elements, in this case, will be the steps or grades in which the variation is produced.

In the opposite situation, if we are not selecting textures, but analyzing a given conjunct of them, we can obtain a description of the relations among the given textures by means of placing them in the paradigm and comparing their dimensions. The positions and the distances among the
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Figure 10. Matrix of logical relations.
textures in the paradigm constitute a parameter for determining their grade of affinity.

**Critical evaluation**

The model described here is an attempt to systematize the knowledge about texture, to have a conceptual tool applicable to different fields and activities: architecture, graphic design, industrial design, painting, etc. This system of texture is not an isolated development. It is part of a more general Theory of Design, which involves also similar models for such subjects as Spatial Delimitation (form), Color, and Cesia (brightness, opacity, transparence, etc.).

As it has been expressed, the system developed here for texture does not include all the possible textures encountered in nature. The paradigm presents only prototypic, simple, and isometric textures, while in nature textures are frequently complex and a-metric. Although this observation may seem an important objection to the system, we can point out arguments to the contrary:

(a) This paradigm is called the 'morphic' paradigm (in relation to the 'morphological' analysis). It only presents the simple textures because the complex ones are considered, in reality, configurations of texture, product of the combination of two or more simple textures. The organization of complex textures will imply the development of a 'tactic' paradigm (in relation to the 'syntactic' analysis), in which the simple textures will be systematically combined.  

(b) The isometry of the texturing elements of our paradigm is not a problem. We have to make clear that when speaking about texture, we are interested not in the shape of the texturing elements, but in the general structure of the texture. This structure does not vary even if we consider small rectangles, circles, or other figures isometric or a-metric, as texturing elements. The notion of texture is simply based on the loss of significiation of the individual elements, for their being incorporated in a general whole. What is meaningful is the composition of that whole, not the composition of the elements.

**Visual textures in relation to objects and interpretants**

The features of texture are, as a general rule, in direct relation with the physical or molecular composition of materials. One significant role of texture is to be a sign or a representation of that physical composition.
It is normal, for example, in architectural plans to indicate the different materials of construction by means of drawing their textures. Sometimes these drawings represent iconically the textures observed in the objects (wood, concrete); other times they represent the materials symbolically, by means of an established code (steel, glass).

As was said, a-metrical or non-regular textures usually denote organic or naturally occurring substances, while metric, isometric, or regular textures often indicate homogeneous, synthetic, man-made materials.

In addition, the type of texture is a sign which can reveal the process of elaboration, treatment, or application a material has suffered. In metals and plastics, extrusion or lamination processes produce lineal textures (e.g., the fine lineal texture of aluminium bars). Fusion, forging, and molding processes produce non-directional textures (e.g., the lightly granulated surface of cast iron).

The directionality of texture can also indicate the treatment done to a material. Longitudinal slices in tree trunks result in pieces of wood with lineal textures, while transversal slices produce non-directional textures.

The mode of application of certain semiliquid substances, such as plaster, mortar, and even some special paints, can modify the final resultant texture. Operations of rasping, streaking, and dripping produce lineal textures; while polishing, troweling, splashing, and blow-piping give non-directional textures to those materials.

The size and density of textures are in direct relation with the grain of materials. The density sometimes depends on the grade of dilution or mixture of one substance into another, when there is a big difference of grain between them.

In all these cases, the visual texture acts as a sign for those objects.

What kind of interpretants are related with visual textures? In what class of other signs can they be transformed as a result of their meanings? Principally, they give birth to synesthetic sensations, the most common being tactile ones. There are numerous words to allude to such signs: smooth, rough, polished, abrasive, coarse, fine, soft, hard.

Also, we find other concepts applied to, or produced as the meaning of textures, perhaps by means of psychological associations: dryness, coldness, warmth, protection, desolation, action, passivity, relaxation, drama.

In relation to the dimensions of texture, Jannello notes that a high density of texture is associated with strength, lineal textures with flexibility, and textures of large size with resistance to weight (1963: 395).

It would be possible to study these signs, classifying them and assigning each one to a determined range in terms of directionality, size, and density of visual texture, as well as analyzing more systematically the (material or immaterial) objects to which the concepts of texture can be applied. I mention these areas as suggestions for future research.
Notes

1. The concepts of representation, design, and drawing are more extensively developed by Claudio Guerri (1987).
2. The numbers refer to the arrangement of Peirce's texts in The Collected Papers of C. S. Peirce. The first numeral is the volume number, and the number to the right of the point is the paragraph.
3. Peirce calls these branches 'pure grammar', 'logic proper', and 'pure rhetoric', respectively. The first and second ones can correspond to Morris's (1938) 'syntactics' and 'semantics', respectively. Peirce's pure rhetoric, however, cannot be compared with Morris's 'pragmatics'.
4. Some years later he added a fourth subject: cesia, which involves visual sensations such as transparency, opacity, opalescence, brightness, translucence, etc.
5. I say 'generally' because it is also possible to produce a-metrical textures by artificial means (for example the texture of a plastic floor imitating granite); we can also find metrical textures in nature (for example, the texture of a honey-comb).
6. Observe also the fact that when we represent a brick wall in a drawing, what we make are lines signifying the joints between the bricks.
7. Among the most important systems of color we can mention the proposals by Wilhelm Ostwald, Albert H. Munsell, and Arthur Pope.
8. For the subject Spatial Delimitation (or form), we actually have a morphic paradigm (for figures) and a tactic paradigm (for configurations) (Caivano and Guerri forthcoming; Guerri 1987). The same will have to be done with Texture.

References

José Luis Caivano (b. 1958) is an architect and a Professor in the Faculty of Architecture, Design, and Town-planning at Buenos Aires University. In 1986 he obtained a three-year grant for research, given by the Science and Technique Secretary of the same university. In 1989 he was a Research Associate at the Research Center for Language and Semiotic Studies, at Indiana University. His principal interest is the study of visual semiotics and theory of design.