LES SIGNES DU MONDE

INTERCULTURALITÉ ET GLOBALISATION

Du 7 au 12 juillet 2004, l'Université Lumière Lyon 2 a reçu sur le Campus Porte des Alpes plus de 600 participants au 8ème Congrès de l'Association Internationale de Sémiotique (AIS/IASS) : « *Les Signes du Monde. Interculturalité et Globalisation* ». Ce congrès accueillait également les collègues de l'Association Internationale de Sémiotique Visuelle (AISV) : *« La société globalisée comme société des images »* ; l'Association Française de Sémiotique (AFS) y tint également son congrès sur le thème : « *Une sémiotique des âges de la vie* ».

48 pays étaient représentés à Lyon :

- *France (189)*
- *Europe hors France (293)* : Italie (54) • Allemagne (36) • Russie (30) • Espagne (23) • Pays•Bas (19) • Finlande (18) • Bulgarie (12) • Danemark (12) • Royaume•Uni (10) • Grèce (8) • Roumanie (8) • Suisse (8) • Belgique (7) • Estonie (7) • Hongrie (7) • Autriche (6) • Pologne (5) • Slovaquie (4) • Suède (4) • Moldavie (3) • Portugal (3) • Chypre (2) • Irlande (2) • Norvège (2) • Tchéquie (2) • Lithuanie (1)

THE "GLOBALIZATION" OF THE SENSES: TRANSPOSITIONS BETWEEN VISION, AUDITION, TASTE, SMELL AND TOUCH

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The associations among different senses are known as synesthesia. This is produced when stimuli received trough a certain sensory channel are perceived and interpreted as sensations of another kind. The most usual transpositions involve vision and hearing, but also taste, smell and touch. A good deal of theoreticians from the fields of psychology of perception and psychophysics have developed order systems for the stimuli or sensations affecting the five basic channels through which humans perceive and process information from the environment. Among these, color order systems are the best known. There are also models that organize visual textures, spatial shapes, and non-visual sensory continua, such as sounds, tactile sensations, tastes and odors. The aim of this paper is to address the concept of synesthesia, to present a survey of some models that organize sensory continua and, from their comparison, speculate about the way synesthetic transpositions that involve vision are produced.

Keywords: sensory continua, synesthesia, vision and other senses, order systems, visual semiotics

INTRODUCTION

Similarities or transpositions between the different senses have been studied both from the psychology of perception and from the arts; for instance, similarities between color and sound, color and taste, color and shape, texture and sound, texture and taste, shape and texture, etc. The general notion behind this is that the senses work somehow related. Using the term in a metaphoric way, we could say that the senses seem to work in a "global" way. When one of them is stimulated, the others are also influenced.

It is not fortuitous that the shapes adopted by the order systems of the different sensory continua (such as color order systems and others) are very similar. Usually, they have a three-dimensional structure arranged according to three axes or variables, which often represent opposite sensations.

Will these order systems represent the way human perception works, then correspondences should appear among them that explain or help to predict how synesthetic associations are produced. The aim of this paper is to address the concept of synesthesia, to present a survey of some models that organize sensory continua and, from their comparison, speculate about the way synesthetic transpositions that involve vision are produced.

SYNESTHESIA

Synesthesia is a phenomenon by which stimuli received through a sensory channel produce sensations of a different perceptual nature. The word *synesthesia* comes from

the Greek (*syn*, together), and *aisthesis* (sensory perception). We could say that it refers to "melted", "confused" or "cross-modal" sensory perceptions.

The most usual associations involve vision and audition —for instance, the typical associations of colors and sounds—, but also the senses of taste, smell and touch. Anyhow, vision seems to be always present associated with the other senses. This phenomenon has been studied from the psychology of perception as well as from neurology. It has also attracted many artists: musicians like Skriabin, plastic artists like Kandinsky, just to mention the most conspicuous. Certainly, it is also a field of great interest for semiotics, and especially for visual semiotics, because of the transformations that occur between perceptual signs and the frequency in which vision appears associated to these processes.

There is no single interpretation of synesthesia. The stream of research coming from neurology distinguishes between two classes: *pseudo-synesthesia* (what we all can experience when recognizing similarities between different kind of sensations), and *genuine synesthesia* (which appears as a neurological abnormal functioning in a minority of persons). It has to be understood, however, that "abnormal" means here that the situation is statistically low (approximately 1 of 25,000 persons).

In *genuine synesthesia* the associations are involuntary, stable —they are repeated consistently along the life of the person—, and unidirectional (a sound may produce a color sensation, but not vice versa). In addition, they are projected outside the individual, not perceived as imaginary but as something present in the nature of the stimulus. The synesthete does not say, "this sound reminds me of red", but "this is a red sound". The following description by Cytowic (1995) gives some hints of what genuine synesthesia implies:

> It denotes the rare capacity to hear colors, taste shapes, or experience other equally startling sensory blendings whose quality seems difficult for most of us to imagine. A synesthete might describe the color, shape, and flavor of someone's voice, or music whose sound *looks like* "shards of glass," a scintillation of jagged, colored triangles moving in the visual field. Or, seeing the color red, a synesthete might detect the "scent" of red as well.

On the other hand, *pseudo-synesthesia* refers to metaphoric associations produced by similitude of qualities, basically to iconic relations between sensations. Precisely, this is the kind of synesthesia that interests me. While a neurologist is concerned with the rare and exceptional clinical cases with the aim of discovering the causes of synesthesia, a semiotician is more interested in how the majority of humans produce associations between different senses, and what kind of semiotic processes are involved.

Differently from genuine synesthesia, pseudo-synesthetic associations are two-directional, or even multi-directional. If a sound evokes a color or is perceived with a similar quality to it, the reverse is also true. In addition, it may simultaneously have a similitude with a shape, a texture, etc. For instance, it is rather common to associate yellow with triangles and high sounds, and any of these signs may act as a trigger for the others.

Also in this kind of synesthesia associations are often stable and consistently repeated not just in a few and rare individuals but practically in all humans. Jakobson (1960 [1985: 169]) mentions that if various people are asked to relate the phonemes /i/ and /u/ with the sensations of lightness and darkness nobody would say that /i/ is the darkest one. Likewise, Kandinsky (1912 [1996: 53-54]) asserts that the acoustic quality of colors is so concrete that nobody would reproduce the impression caused by yellow on the low keys of the piano, or describe a dark paint with a soprano's voice.

In this way, pseudo-synesthesia can be considered a normal phenomenon of semiotic association, either culturally induced or product of neural connectivity. There is a hypothesis that in the first months of life, the babies' senses work typically in a synesthetic and global way. In growing up, the sensory channels undergo a progressive separation, becoming more specific and tuned to certain kind of stimuli. If this were so, an adult genuine synesthete would be a person whose sensory systems, instead of evolving, remained in the initial stage. It seems logical that in normal persons could also happen that some traces of that stage remain.

ORDER SYSTEMS OF SENSORY CONTINUA

Let's now go to the order systems of sensory continua. A good deal of theoreticians, specially from the fields of psychology of perception and psychophysics, have developed order systems for the stimuli or sensations affecting the five basic channels through which humans perceive and process information from the environment. Among them, color order systems are perhaps the best known. There are also models that organize visual texture, spatial shape, and non-visual sensory continua, such as sound, touch, taste and odor.

Color order systems

I will start with the more familiar models: color order systems. Many of these models have been developed along the history of color research. Some of them arrange the physical stimuli, color-light or color-pigment, while others are oriented towards the chromatic sensation.

Among them, the Natural Color System is the result of putting the opponent-colors theory of vision into practice. This system is represented as a double cone. A chromatic circle shows the oppositions among the four elementary colors (yellow-blue, and red-green), while a vertical axis represents the opposition between the two elementary achromatic sensations (white-black).

This system intends to be a representation of how humans perceive color. Since the second half of the 20th century, the research on color vision has demonstrated that in spite that the retina works as a trichromatic system, at later stages in the processing of visual stimuli the functioning is typically that of chromatic opponency.

All modern color order systems have a three-dimensional structure, representing the three variables of color. In the Natural Color System, these variables are: hue, blackness, and chromaticness. In addition, it has three pairs of oppositions that work as three axes in space: the yellow-blue, red-green, and white-black axes (Figure 1). For additional information on the NCS, see Hård and Sivik (1981), SIS 1996, Hård, Sivik and Tonnquist (1996).

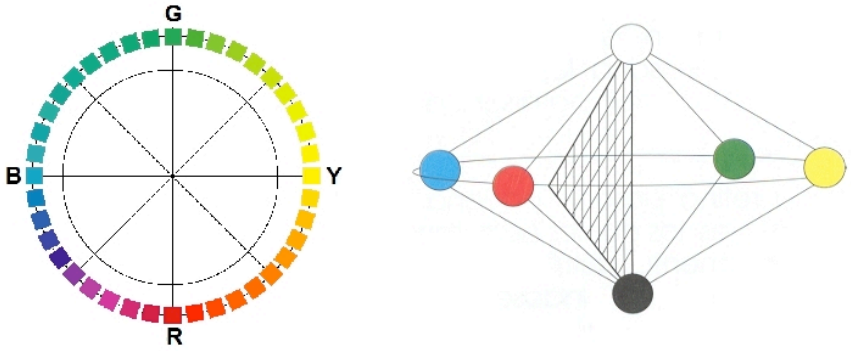

Figure 1. The Natural Color System: chromatic circle and three-dimensional model, a double-cone, with the six elementary color sensations.

The order system of cesias

The word "cesia", invented by César Jannello, refers to the visual sensations produced by different distributions of light in space, in its interaction with objects (absorbed, transmitted or reflected light, either diffusely or regularly). Cases of cesia are: transparency, translucency, matte appearance, mirror-like appearance, gloss, and all intermediate situations, with different degrees of intensity.

The model that I developed arranges cesias according to three variables (Caivano 1991, 1994, 1996, Caivano and Doria 1997). Lightness varies in a vertical axis (such as in color order systems), with the lightest sensations above and the sensation of black below. Diffusivity varies in another axis, from mirror-like appearance and transparency to matte appearance and translucency. Finally, in a third axis, the variation of permeability or opacity occurs, that is, the quality of letting light pass trough or not (Figure 2).

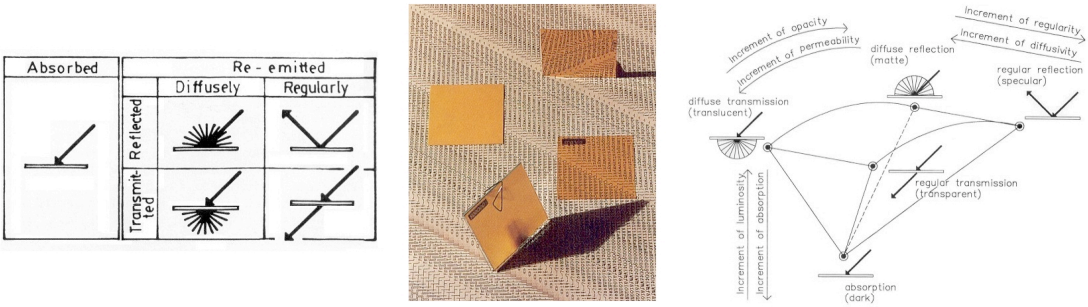

Figure 2. The order system of cesias: possibilities of spatial distribution of light (left), four basic cesias (center), and three-dimensional model (right).

The order system of spatial shapes

In my opinion the most coherent intent to create an order system for spatial shapes is the one by Jannello (1984). In his system of two-dimensional figures, the tree variables are: form-matrix, size, and saturation. The model adopts the shape of a half cone pointing downside. In one of the extremes of the half-circle the triangles appear, while in the opposite extreme the circle and their descents, the ellipses, are placed. In the middle, all the different regular polygons, arranged by number of sides, appear. Each polygon undergoes the transformation of size and saturation in a triangular plane where the

saturated figure (the regular polygon) appears opposed to the unsaturated figure (the line), and the variation of size occurs from a certain size to a point (Figure 3).

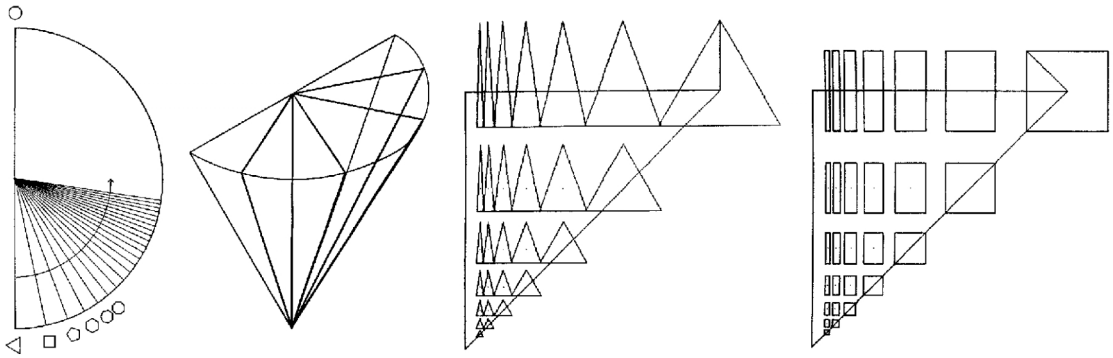

Figure 3. Jannello's order system of spatial delimitations, or shapes: the half-cone seen from above and in perspective, and the development of two triangular planes with the variation of size and saturation.

The order system of visual textures

Texture can be considered as a visual or tactile sensation. For vision, the perceived qualities of texture may be: directionality, size, and density. Jannello (1961) proposed a cubic model to arrange what he called the "texturing element", not the texture itself but the minimal unit whose repetition generates a texture (Figure 4, left).

In the journal *Semiotica* I published a model that, using Jannello's variables, intends to organize the textures already developed in extension (Caivano 1990). Each plane where textures of equal directionality are held together —while size and density vary— adopts the shape of a triangle. Along another axis, all the planes with textures of different directionality are arranged having the size zero as a common point. The complete model has a half-cone shape (Figure 4, center and right).

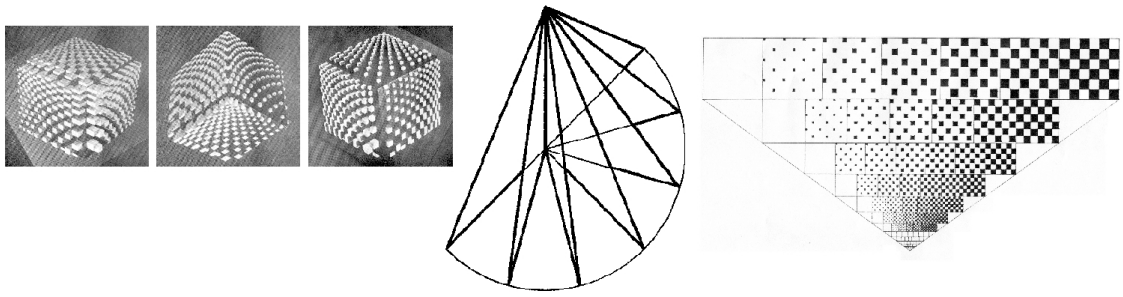

Figure 4. Order system for visual textures: Jannello's cubic proposal (left); half-cone model (center) and development of one plane of this model (right).

The order system of touch sensations

Leaving the field of vision and entering into touch sensations, we can arrive at a rather complex order system by following the researches by David Katz (1925) and Sven Hesselgren (1967). Katz introduces the oppositions hard-soft and smooth-rough, which gives us two axes of variation. Hesselgren (1967: 106) adds the elastic-plastic opposition, with which we already have a three-axis model: a cube. By adding the

warm-cold pair, the system grows to four dimensions (Figure 5). We could even add the dry-wet opposition, pointed out by Juan Carlos Sanz (1985: 77-78, 1993: 192), and thus arrive to a five-dimensional system, which is more difficult to represent graphically. While all these qualities can be perceived by touch, only some of them could be described as textural qualities, the others deviate from the notion of texture.

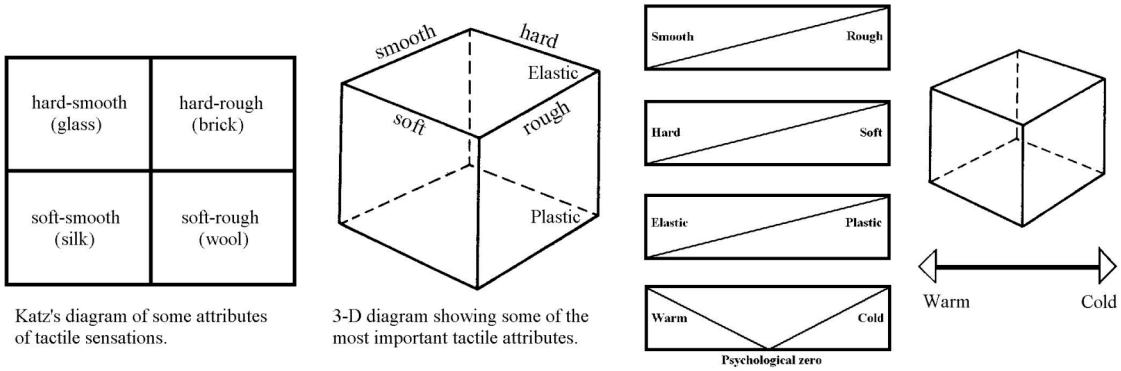

Figure 5. The organization of touch sensations.

The order system of odors

There are also proposals of order systems for the sense of smell. With his love for classification, Linnaeus was first in proposing a list of seven categories of smell in the middle of 1700. Already in the 19th century, Zwaardemaker reformulated Linnaeus' classificatory system and enlarged it to nine categories. Finally, Henning transformed the list into a three-dimensional system where odors vary in a gradual continuum and are related to one another. The model adopts the shape of a triangular prism. In its six vertices, Henning places the six fundamental or primary odors (with the same implication than the primary colors): flowery, foul, fruity, spicy, burnt, resinous. Any simple odor occupies a certain place along the borders of this solid, and the complex or composite odors, that are a mixture of simple odors, are placed inside.

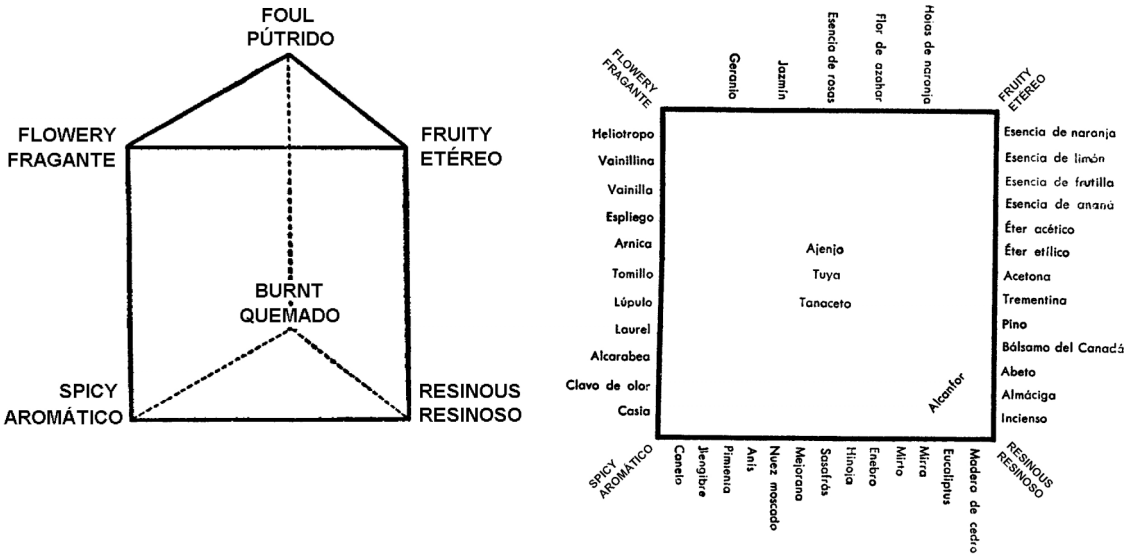

Figure 6. Henning's order system of odors: the prism, and the development of the FFRS square, one of the faces of the prism.

The order system of taste sensations

With his passion for three-dimensional models, Henning also proposed a solid to represent the order and variation of taste sensations: a tetrahedron, with the four basic tastes: sweet, saline, bitter, sour. These four tastes hold a correlation with four specific zones in the main organ of taste, the tongue. That is to say, as with the Natural Color System and the opponent-colors theory of vision, there is also here a correlate between the order of sensations in the model and the way the organs or perception systems work.

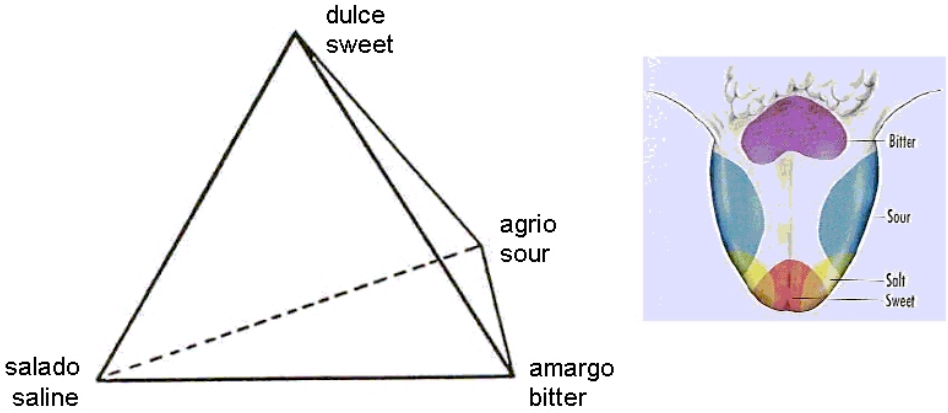

Figure 7. Henning's tetrahedron of taste sensations, and the localization of the four basic tastes in the tongue.

HYPOTHESIS

Let's now present the following hypothesis:

- If we understand synesthesia in a broad sense, as cross-modal sensory associations between sensations of different kind, that are perceived by all persons (not only as a neurological anomaly);
- And if the order systems (of color, shape, texture, smell, taste, etc.) represent the way humans perceive and organize the corresponding sensations;
- Should some kind of relationship between synesthesia and order systems exist? That is to say, should the positions of the sensations in the different order systems have a correlate, as a result of the synesthetic associations that are consistently produced?

In a concrete example, if people were asked to relate light and dark colors with high and low sounds nobody would say that the dark colors resemble the high sounds. Then, in both systems, for color and sound, the correspondences between the polar positions light-dark and high-low should be verified.

POSSIBLE CORRESPONDENCES

From that general hypothesis we could imagine particular cases of association, and verify whether they appear at a high rate in normal persons (not in clinical cases of synesthetes) or not. Let's see:

- The variation of hue in color would be similar to the variation of form-matrix in two-dimensional figures. We have seen that Kandinsky associated three basic hues (yellow, red, and blue) to three basic shapes (triangle, square, and circle). Itten extended this association to six colors and six shapes, taking some intermediate cases.
- The light-dark opposition in color could resemble the opposition of small to big, the size of shapes.
- The chromatic-achromatic opposition (for instance a pure red as opposed to a gray) would resemble the opposition between saturated and unsaturated shapes (for instance, the square, as a two-dimensional shape with highest saturation, opposed to a segment of line, as a one-dimensional shape, the minimal possible saturation).
- Linnaeus' seven olfactory categories could be compared with the division of the spectrum in seven colors by Newton, who, on the other hand, was searching for a correlate with the seven tones of the musical scale.

After the comparison of the models, their opposite sensations and their variables, it is possible to detect certain axes of coincidence. Most of the models have a vertical axis with an opposition pair that could be associated to the "heaviness" of the sensations, a quantitative aspect:

	<u>light - heavy</u>
COLOR	light - dark
CESIA	light - dark
SOUND	high - low
SHAPE	small - big
VISUAL TEXTURE	small - big
ODOR	fruity - resinous
TASTE	sweet - bitter
TOUCH SENSATION	soft - hard

Perpendicular to this axis it often appears another, which has to do with the saturation of the sensations, a quali-quantitative aspect:

	<u>saturated - unsaturated</u>
COLOR	chromatic - achromatic
CESIA	regular - diffuse
SOUND	pure sound - noise
SHAPE	surface - line
VISUAL TEXTURE	dense - sparse
TASTE	tasteful - tasteless
TOUCH SENSATION	rough - smooth

The third variable is usually of a more qualitative nature. In some cases, instead of being a continuum between two opposite poles, it adopts a circular way, as in the chromatic circle:

COLOR	*hue* (chromatic circle: yellow-red-blue-green-yellow...) (oppositions: yellow-blue; red-green)
CESIA	*permeability* (transparent - opaque)
SHAPE	*form-matrix* (triangle - circle)
VISUAL TEXTURE	*directionality* (directional - non-directional)

These are just some hypothesis of the similarities that could be recognized between qualities of different sensory nature. There is probably more than this. Is it possible to verify theses correspondences?

VERIFICATION BY SURVEYS

By means of surveys or experiences with normal persons (not clinical synesthetes), we could verify whether those correspondences are shared by most people in a natural way, or change (and then new hypothesis would be needed), or are affected by other factors (sex, age, instruction, profession). No doubt, this is a long-term research program. Particularly, I have carried out two experiences in this direction: with color and sound, and color and shape.

Color and sound

In a paper published in the journal *DeSignis* (Caivano 2003) I develop the associations between color and sound, and present the results of a survey with normal persons (not genuine synesthetes) about the associations among the variables of color (hue, lightness, saturation, and spatial extension) and the variables of sound (pitch, loudness, timbre, and duration). The results were that most people relate:

- pitch of sound with lightness of color,
- loudness with spatial extension of color,
- timbre of sound with hue of color,
- duration of sound with spatial extension of color.

In addition, the associations were markedly pointed out in this direction:

- low sounds with dark colors,
  high sounds with light colors;
- quiet sounds with small color extensions,
  loud sounds with big color extensions;
- noise with violet (one of the extremes of the spectrum),
  pure sounds with red (the other extreme of the spectrum);
- short sounds with small color extensions,
  long sounds with big color extensions.

Color and shape

In my color seminars I usually test the color-shape associations supported in the Bauhaus by Kandinsky and Itten (see Itten 1961 [1970: 75-76]). They asserted that:

- yellow is associated with the triangle,
- red, with the square,
- blue, with the circle.

In the surveys with my students, I ask them to relate these colors to these shapes. I show them black outlines of the three shapes and long stripes with the three colors. The results are:

- ***64 % relate yellow with the triangle***
  (26 % relate yellow with the circle, and 10 %, yellow with the square),

- ***48% relate red with the circle***
  (33 % relate red with the square, and 19 %, red with the triangle),
- ***57 % relate blue with the square***
  (26 % relate blue with the circle, and 17 %, blue with the triangle).

As we can see, there is no doubt about the yellow-triangle association. But the other results contradict Kandinsky-Itten's presuppositions about red and blue, even when the percentages are not so high as to give a definitive answer. At least it seems that in these two last cases the associations are not so strong or universal.

CONCLUSION

This kind of surveys could be extended to the other associations that we hypothesized for different sensory continua. If it were verified that the associations are not fortuitous but have a definite and consistent tendency, this would suggest that:

- Either the iconic analogies or resemblances are structural and rather universal,
- Or the neurophysiological links that produce synesthesia are not contingent or a privilege of a few rare individuals, but are shared by most humans, perhaps as a trace of the initial stage of sensory development in the first months of life.

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