DiPAV, 2006, 16, 109-126

TWO IMAGES IN ONE. RETHINKING ILLUSIONS LOOKING "THROUGH" ALBERTI'S WINDOW.

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Sommario

Nella prima parte di questo contributo, il paradigma dell'errore dello stimolo viene usato per mostrare la percezione di dualità-identità che caratterizza i classici fenomeni percettivi che vanno sotto il nome di "illusioni".

Nella seconda parte, le ricerche sulle illusioni sviluppate nell'ambito della psicologia della percezione vengono confrontate con l'uso di effetti illusivi nelle arti figurative pittoriche. A questo confronto viene aggiunto quello tra immagini Picture-view (fotografiche) e Mirror-view (speculari).

Nella terza parte mostreremo come la dualità-identità delle immagini Picture-view e Mirror-view, è contenuta nella famosa tavola del battistero di Brunelleschi e nell'invenzione albertiana del piano pittorico che corrisponde ad una sezione del cono ottico (finestra albertiana).

Abstract

In the first part of this work, the "stimulus error" paradigm is used to show how the classic perceptual phenomena known as "illusions" are perceived as being characterized by duality and identity.

In the second part, research on illusions as developed in the field of the psychology of perception is compared to the use of illusory effects in pictorial figurative art. This is further extended to a comparison between Picture-view and Mirror-view images.

Finally, it will be shown that the duality-sameness of picture and Mirror views is present in Brunelleschi's well known "peepshow" experiment and in Alberti's front picture plane (Alberti's window).

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1. The fuzziness of the term illusion

In the literature of Psychology, the term “illusion” is used to cover a broad set of phenomena.

This set has fuzzy boundaries. Sometimes it seems to overlap, either partially or totally, with phenomena described by other terms such as multi-stability (Attneave, 1972), singularity (Burigana, 1996), anomalous figures and illusory contours (Kanizsa, 1955). For a review and discussion, see Coren & Girgus (1978).

Vicario (who is working on a taxonomy of more than thousand geometric optical illusions) observes that “in the most famous reviews available thus far, from Wundt’s (1898) to Goto & Tanaka’s (2005), geometric optical illusions are presented together with other phenomena such as chromatic contrast, anomalous surfaces, masking, ambiguous figures, reversible figures, etc”.

Geometric Optical illusions. The framework of this analysis is the bigger set of geometric optical illusions (referred to from now on as GO Illusions) – as named for the first time by Oppel in 1855 (p. 37 -38). Put simply, these illusions are concerned with the estimation of size, shape or spatial localization of the visual structures in question.

Fig. 1 - Crooked oar

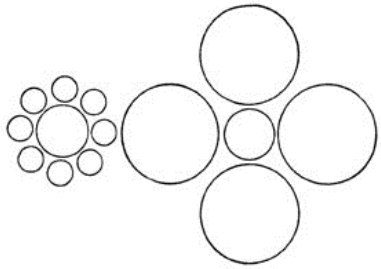

Fig. 2 - Ebbinghaus

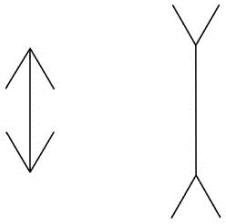

Fig. 3 – Müller-Lyer

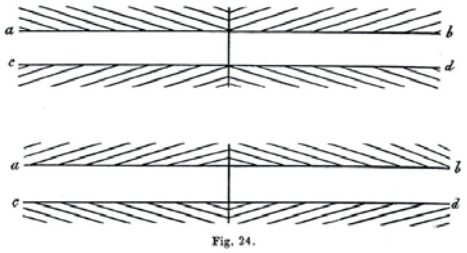

Fig. 4 - Hering

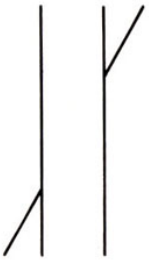

Fig. 5 - Poggendorf

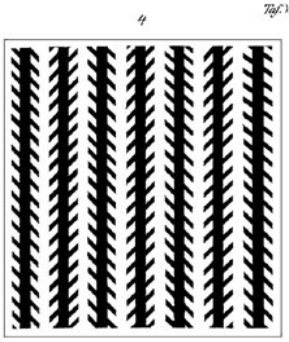

Fig. 6 – Zollner

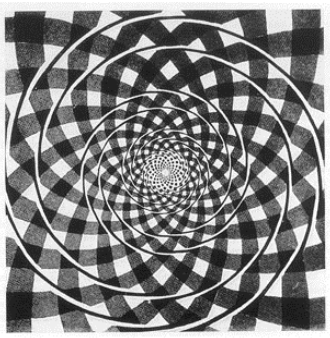

Fig. 7 - Frazer

The 5 necessary conditions for GO illusions. We will show that there are at least 5 necessary conditions to identify a perceptual image as a GO Illusion. Namely:

1. a genuine perceptual doubt;
2. two successive temporal moments (t1 and t2);
3. an empirical procedure of verification;
4. the result of the verification showing that the same figure has in fact two opposite properties;
5. the experience of "exhaustiveness" in the empirical verification carried out in t2.

Description of an experience of GO illusion. Take a naïve observer, a researcher and some visual configurations that the researcher knows belong to the category of GO illusions.

If this naïve observer is presented with one of these configurations and given the task of describing it, there are two possible outcomes in t1:

t1 a) the naïve observer describes what he/she sees.

In this case there is no "illusory" experience. The naïve observer sees a crooked oar, two parallel lines (one shorter than the other), a spiral etc….. and then describes exactly what he/she saw, i.e. a crooked oar, two parallel lines (one shorter than the other), a spiral etc.

If the image shown in Figure 8 is under observation, in optimal visual conditions the person would leave the room without being aware of the illusion, having only seen an open door and, through it, another door with a violin hanging on it.

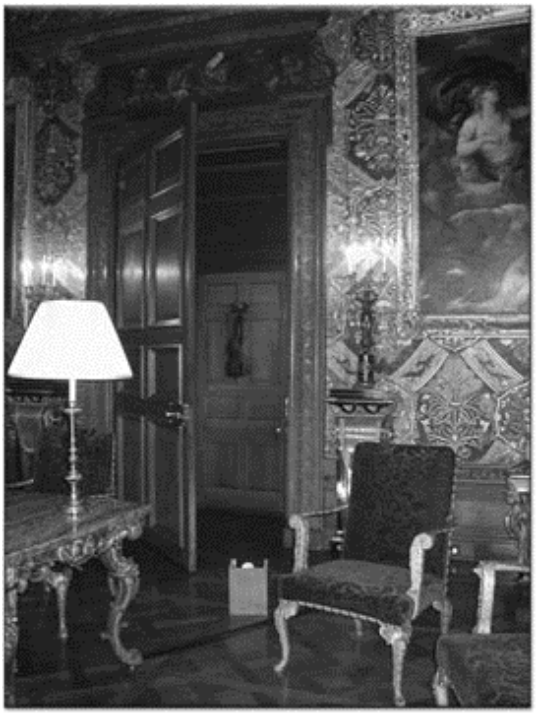

Fig. 8 -van der Vaart (attr.), Violino dipinto. Devonshire Collection, Chatsworth, Inghilterra

t1 b) the naïve observer seems to harbour a doubt that the image would remain exactly the same (Bozzi, 1969) if he/she changed some aspect of the

configuration or the conditions of observation – i.e. doubts of the "robustness" (cfr. Kubovy, 1986) of his/her perception.

Before getting into an analytical discussion of the 5 conditions, here is WARNING about methodology: To avoid descriptive errors in t1 and t2, the descriptions must conform to a series of conditions defined by the Stimulus Error formula (Boring, 1921; Kohler, 1929; Bozzi, 1972; Kanizsa, 1972). These conditions concern the type of observer; the means he/she uses to observe the phenomena; the object under observation; the language he/she is supposed to use and the kind of description he/she is asked to give (see Savardi & Bianchi, 1997, 1998). So, for instance, a description of the physical properties of the stimulus should not be confused with a description of its perceptual properties; a description of what one knows should not be confused with a description of what one sees; a description of the neurophysiological conditions during the process of observation should not be confused with the experience of observation; an analytical and de-contextualized description (e.g. peephole) of certain properties of the object under observation should not be confused with a description of the object as a whole; an expert description should not be confused with a naïve one, etc. To best describe an "Illusion" from a phenomenological viewpoint, the observer's experiences in t1 and t2 must be expressed in a way that satisfies the conditions of percept-percept coupling (Bozzi, 1989; Epstein, 1982; 2003; Rock, 1997) i.e. there is a reference to perceptual properties and perceptual relations, as well as "coupling" relations between t1 and t2.

1.1 Condition 1 - A genuine perceptual doubt.

A genuine perceptual doubt is necessary because something – an independent insight on the part of the observer, the conditions surrounding the experiment, or an expert interacting with the observer – must stimulate the observer to carry out a second observation in order to verify the perception experienced in t1.

We would like to emphasize that what we mean by genuine perceptual doubt is not the doubt as described by Descartes (Bozzi, 1972; Ferraris, 2005; Spinicci, 2005), which was:

a) generalized for all phenomena, and was thus a general "principle" for the deception of the senses and which

b) originated from the ontological distinction between reality and appearence.

The kind of doubt we are referring to here is specifically based on the perceptual constraints of the figure under observation (We believe Descart could be absolved because his doubts were based on empirical foundations).

In this sense, the genuine perceptual doubt regarding illusions may be considered more similar to other doubts about perceptual experiences in t1, which require further verification in t2. These doubts are also usually associated with a sense of having made a mistake (Reason, 1990; Norman, 1981). For instance, when we are not sure if what we hear is actually an external noise rather than something else (e.g. the roar of a plane), we start a "second" auditory check, possibly with another person ("Can you hear that?"). Or, when we are frightened by an unidentifiable movement, which we see outside our windows at night (t1), we check again (t2), trying to verify what we saw in t1.

1.2 Condition 2. Two successive temporal moments (t1 and t2)

Every experience that includes the awareness of a GO illusion is characterized by two separate temporal moments, corresponding to two "observation sessions" for the same figure. The second session (t2) exists only if a doubt is present in t1 and is activated in order to resolve the doubt by means of an empirical procedure of verification (3).

1.3 Condition 3. An empirical procedure of verification.

Just as the doubt in t1 is a perceptual doubt, the resolution of this doubt must be perceptual (percept-percept coupling).

The verification process can be carried out in different ways. It usually involves the use of:

a. measuring instruments (e.g.: I measure the length of the Muller-Lyer horizontal lines with a ruler or with a piece of paper used as a ruler);

b. alternative sensorial checking methods (e.g. I touch the crooked oar under the water in the supposedly "crooked" point; I follow the lines of the Frazer spiral with my finger…);

c. checking methods using the same sense, but isolating the elements of the configuration that are being focused on (e.g. I get the oar out of the water, or I delete the oblique segments at the extremes of the Muller-Lyer central parallel lines).

1.4 Condition 4 - The result of the verification showing that the same figure has in fact two opposite properties.

Previous experiments (Savardi & Bianchi, 2000; Savardi, Bianchi, Kubovy, in preparation) have demonstrated that there is strong evidence for geometric optical properties to be perceived by naïve observers as being organized into opposite properties (e.g.: near-far, big-small, long-short, narrow-wide…). One could thus predict that all perceptual doubts in GO illusions would be resolved by finding, in t2, an opposite property with respect to that found in t1. The outcome of the verification process is that the observer realizes that:

- the crooked stick (t1) is straight (t2);
- the same two central circles of the Ebbinghaus configuration are one bigger than the other in t1 and of equal size in t2;
- the central parallel lines of the Muller-Lyer are one short and the other long in t1 and of equal length in t2;
- the same lines in the Zollner and the Hering configurations are curved in t1 and parallel and straight in t2;
- the oblique line in the Poggendorf configuration is offset in t1 and aligned in t2.

This co-existence gives rise to an experience of perceptual dissonance or perceptual violation of the non-contradictory principle thus causing the surprise and sense of error which characterize the GO illusion experience.

1.5 Condition 5 - The experience of "exhaustiveness" in the empirical verification carried out in t2.

In all classic GO illusions, it is not only what we perceive in t1 that is phenomenally evident (shorter-longer lines in the Muller-Lyer; crooked stick; spiral shape in the Frazer configuration: bigger-smaller circles in the Ebbinghaus figure …). The outcome of the verification process, i.e. what we perceive in t2, is also phenomenally evident (identical length of the lines; straightness of the stick; concentric circles; identical size of the circles…).

There are no aspects "left out" in the verification process: I recognize that what I see in t2 is the same as what I was looking at in t1. I not only see but I can also demonstrate phenomenally this sameness in terms of what I saw in t1 and what I'm measuring, re-observing and describing in t2.

To summarize this first part of the analysis: the class of perceptual experiences that fall into the category of GO illusions is characterized by perceptual dissonance. This is due to the recognition of the co-existence of opposite properties in the same configuration - in fact we see only one configuration, not two; t1 and t2 together constitute the phenomenon as a unit. This co-existence is the result of a satisfactory verification (percept-percept coupling), activated as a consequence of a perceptual doubt based on the characteristics of a given visual structure.

Is the analysis carried out up to this point limited to the set of figures belonging to the class of "laboratory GO illusions"? What happens when we consider images where the aim of the artist is that they are almost IDENTICAL copies of the external world and that are constructed by applying geometric optical rules? When these images succeed in producing an "illusory experience", does this illusory experience conform to the 5 conditions for GO illusions described before?

2. Illusionistic paintings and illusionistic painted architecture.

Many authors have talked of "illusionistic painting", illusionistic painted architectures and, in general, illusory effects with respect to pictorial representations. To mention some of them:

- SHERMAN (1983) states that the deliberate search for illusory effects has characterized three centuries of art: from Brunelleschi to Renaissance and Baroque Illusionism. Renaissance Illusionism featured ceiling and dome representations as well as painted canvas backdrops for religious plays. The painted scene appears to be an extension of the real scene.
- KEMP (1990) emphasizes that the study and application of the rules of perspective are closely associated with the search for realizing illusory effects and illusionistic architecture. (For an extended bibliography on the topic, see footnote 42, chapter II; and paragraph "Italy: illusions and mathematics", chapter II, pp. 81-114).
- STERLING (1959) defines tromp l'oeil as a type of painting that aims to hide the fact that it is a painting and wants instead to be a fragment of reality. "*Le tromp l'oeil est une peinture qui veut faire oublier sa qualité de peinture, qui prétende être un fragment de la réalité*"
- KUBOVY (1986, chapter 4) refers to the pictorial effects he has been discussing [robustness of perspective, tromp l'oeil, Pozzo's ceiling fresco ….]

saying that “all fall into the broad category of illusion.” With reference to the perception of the ceiling in the Church of St. Ignatius, Rome, see also Massironi and Savardi (1991).

Fig. 9 - A. Pozzo. Gloria di S. Ignazio. Chiesa del Gesù, Roma.

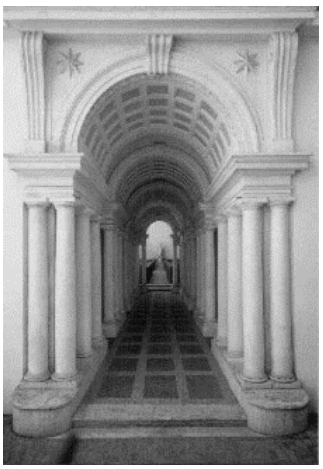

Fig. 10 - Galleria Borromini, Palazzo Spada,

Fig. 11 - Studiolo Duca di Montefeltro, Urbino

If you apply the 5 conditions described before to the "illusionistic experience" that an observer has when looking at paintings or pictorial architecture, you will see that all 5 conditions fit perfectly to this special class of GO illusion.

3. Illusionistic images in paintings and Illusionistic mirror images.

In the process of creating illusory effects in paintings, mirrors are considered to be the best medium because they conform completely to geometric optical rules, and are thus very good for creating illusionistic images. Leonardo da Vinci had a good explanation for why mirrors are the "maestro" of painters: *"402. Come lo specchio è maestro de' pittori. Quando tu vuoi vedere se la tua pittura tutta insieme ha conformità con la cosa ritratta di naturale, abbia uno specchio, e favvi dentro specchiare la cosa viva, e paragona la cosa specchiata con la tua pittura, e considera bene se il subietto dell'una e dell'altra similitudine abbiano conformità insieme. Soprattutto lo specchio si deve pigliare per maestro, intendo dire lo specchio piano, imperocché sulla sua superficie le cose hanno similitudine con la pittura in molte parti; cioè tu vedi la pittura fatta sopra un piano dimostrare cose che paiono rilevate, e lo specchio sopra un piano fa il medesimo; la pittura è una sola superficie, lo specchio è quel medesimo; la pittura è impalpabile, in quanto che quello che pare tondo e spiccato non si può circondare, con le mani, e lo specchio fa il simile. Lo specchio e la pittura mostrano la similitudine delle cose circondata da*

ombre e lume, e l'una e l'altra pare assai di là dalla sua superficie. E se tu conosci che lo specchio per mezzo de' lineamenti ed ombre e lumi ti fa parere le cose spiccate, ed avendo tu fra i tuoi colori le ombre ed i lumi più potenti che quelli dello specchio, certo, se ti li saprai ben comporre insieme, la tua pittura parrà ancor essa una cosa naturale, vista in un gran specchio."

4. Giulio Romano's technique

Kemp (1990, P. 84, Fig. 131) recounts that among the techniques used by Giulio Romano (Raffaello's principal assistant) to create perspective there was one which required the painter to copy what appeared on the surface of a mirror.

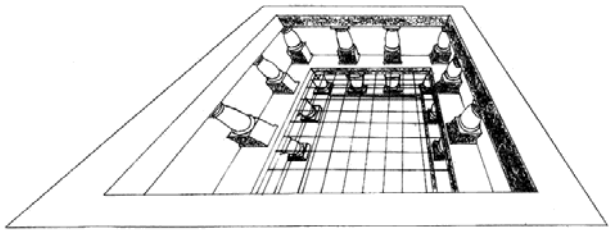

Fig. 12 -Use of a model and a mirror, according to Giulio Romano's technique, to create the geometric projection for an illusionistic image of a building on a ceiling. As described by Cristoforo Sorte (Giulio Romano's assistant): "Make a model of an open loggia and put it on a mirror with a grid. Established a fixed point of view and copy the mirror image, square by square, on a paper with the same grid printed on it." (FIG. 131, from Kemp, p. 84)

5. Brunelleschi's peepshow experiment.

A decade before Alberti's theoretical work on the rules of perspective, Brunelleschi did an interesting experiment to demonstrate that the projection method (i.e. pictures correctly embodying linear perspective) is an effective method for the creation of an illusion of depth. He used a panel he painted with a view of the church of the Florentine Baptistry, as seen from a point about five feet inside the portal of Santa Maria del Fiore. He made a hole the size of a lentil on the painted side of the panel. This hole

opened like a cone towards the back of the panel. He wished the eye to be placed at the back, where the hole was larger, with the one hand bringing the panel close to the eye and the other holding a mirror in front of the panel so that the painting would be reflected. It seemed as if one was looking at the real Baptistry. "*I have had the painting in my hand and have seen it many times in these days, so I can give testimony*." (from Manetti's biography, trans. by White, 1968, pp. 114-17; see also Kubovy, 1986, Chapter III)

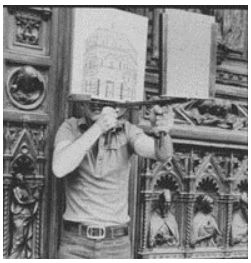

Fig. 13 -A) A reconstruction of the first panel and how it was held.

Fig. 13 -B) Demonstration that the mirror image of the picture of the Baptistry, from the location at which Brunelleschi depicted it, has a GO organization consistent with real scene with which it overlaps (a successful illusion).

Similarities between Mirror Images and Pictorial Images when producing an illusory effect. The examples discussed before confirm that GO illusions may be effectively created by both pictorial images and mirror images. Pictorial images (or picture-view/normal-view images) and mirror-view images are the only two possible "views" of the external world.

The final question we would now like to address concerns the relationship between picture-view images and mirror-view images with respect to the 5 conditions for GO illusions. The crucial difference concerns the 5th condition, which regards the experience of exhaustiveness in the empirical verification of the sameness of an object as compared to its reflected image (when an asymmetrical object is considered).

6. Methods for verifying sameness between real and virtual "objects" as proposed in literature.

The problem of left-right reversal in mirror-images is the central point of what is known, in the literature of Psychology and Philosophy, as the "mirror question". In this literature, three kinds of verifications are proposed:

1 – geometric demonstration of point-by-point correspondence (see Gregory, 1996; Haig, 1993; Tabata & Okuda, 2000)

2 – geometric demonstration based on rotation in the fourth dimension (analogous to rotation in the 3rd dimension to demonstrate the sameness between 2D figures and their reflections and to rotation in the 2nd dimension to demonstrate the sameness between 1D figures and their reflections).

3 – "inside-out glove demonstration" (Takano, 1998): "*You are therefore invited to imagine a back-front reversal of yourself, with your nose, face, eyes, and so forth pushed through to the back of the head, and your back somehow oozed through the front. You might then "feel" your watch as having remained on your left wrist (say), while back and front have reversed. However it is likely that you will also experience a strong compulsion to recalibrate your internal axes, and then feel the watch to be on the right wrist. (…) If this demonstration does not work, here is another exercise (…): Imagine that the heel and toe of your left shoe are exchanged, while the top and bottom of the shoe, and its left and right sides, remain unchanged. This back-front reversal again produces the enantiomorph of your left shoe, which happens to be the same as your right shoe*".

Now, the question is: Are These "Exaustive" verifications? Verifications 1 and 2 are beyond naive observers' experience and also beyond their imagination. Moreover they are perfect examples of

explanations affected by stimulus error, because they confuse physical (optical) and perceptual descriptions (Savardi, Bianchi 2005). This criticisms has also been made by:

- Ittelson, Mowafy and Magid (1991, p. 572): "*We cannot assume, however, that a physical description of the stimulus constitutes an adequate description of the psychological response*"

- Takano (1998, p. 37): "*According to this line of argument (…) one could maintain that the Müller-Lyer illusion, for example, is not worth investigation because the two compared lines are identical in length from a geometrical point of view. The mirror reversal problem arises from a discrepancy in recognized directions, just as the Müller-Lyer illusion arises from a discrepancy in recognized lengths*".

Verification 3 is very hard to imagine, and in any case it leaves you with the opposition between the inside-out image and the "normal" image. If you ask naive adults looking at their mirror image how can they verify the sameness between themselves and their image, what would they say? To answer this question we will consider the distribution of the responses given by 21 adult participants in an experiment carried on in the Psychology Laboratory, Verona University (see Tab. 1). In the first part of the experiment (Savardi & Bianchi, 2005) they were asked to describe the relationship perceived between their image and their real body in terms of sameness, similarity, difference, oppositeness. Different mirror positions, different gestures as well as different types of description were studied.

Tab. 1: Distribution of the responses of subjects (see text)

Type of proof proposed	Observed N	Expected N	Residual	Percentages
A. Movement	11	7,0	4,0	52.38
B. Coincidence of the body parts when in close proximity to the mirror	18	7,0	11,0	85.71
C. Mental rotation	3	7,0	-4,0	14.29
D. Sameness of the virtual and real environment around the observer	1	7,0	-6,0	4.76
E. Mental flattening of 3D bodies into 2D surfaces	2	7,0	-5,0	9.52
Total	35			

Since sameness (together with oppositeness) was the most frequent response at various description levels, the last question in the experiment

asked participants how they could demonstrate this sameness. Percentages are calculated on the total number of subjects (n=21). Each subject could in fact suggest more than one solution. Are naïve observers able to give an "EXHAUSTIVE" proof of the sameness they perceive when looking at their image in a mirror? Again, these aren't "exhaustive verifications", because they always leave out oppositeness (in A, C, and D: left-right oppositeness; in B, and E: back-front oppositeness). All subjects reported their disappointment that the solution was not exhaustive and convincing. What might be an "exhaustive" empirical verification (i.e. with oppositeness not left out) of the sameness between the object, or picture-view, and its mirror image? If (see Fig. 14)

a) we consider Alberti's window (or the mirror surface) as a section of the optical cone and

b) we look at this section moving the Point of View, in P1, to the Vanishing Point, in P2, we will see the picture on Alberti's window from the back. That image will correspond to the same seen image from P1, as reflected in a mirror;

then we can see and exhaustively verify the sameness of the two images on the surface of the mirror or the window.

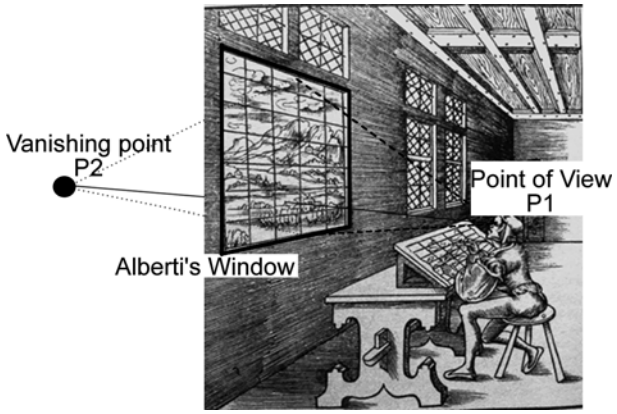

Fig. 14 –The Alberti's window, adapted from Dürer.

To put in another way:

If

a) we consider Alberti's window and the mirror surface as two sections of the optical cone, positioned one beside the other, and

b) we then fix two points of view, first looking at these sections from one side (P1) and then from the other side (P2)

we can see that, by changing the point of view, the images are the same, (Fig. 15) and we can also rotate the window around a rotation axis .

Fig. 15 –The two views of the window in Fig.14.

Instead of using a mental experiment, we can simulate this demonstration (with a certain degree of aprossimation) by printing the image, mirror-view or picture-view, on a transparency and look at it from both sides.

Conclusion

What we have proposed is an analysis of the "mirror image illusion" based on a more general analysis of the structure of GO illusions, carried out from a phenomenological point of view.

This way of "rethinking illusions" shifts the analysis

- away from the binomial real-apparent
- towards the recognition that some phenomena are characterized by the perception, on the part of the observer, of oppositeness co-existing with the recognition of sameness.

This holds for classic laboratory OG illusions and picture-view images as well as for mirror-view images.

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