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Contraries in Art: A Glance at the Structure of Mirror Reflections

Introduction

The contribution presented in these pages lies in that area of theoretical and empirical research which connects art with the studies carried out by psychologists of perception working within the framework of what today is known as "neo-Gestalt Psychology" (e.g. Wagemans et al. 2012a, 2012b) or, according to the Italian tradition, "the Experimental Phenomenology of Perception" (e.g. Kanizsa 1979; Bozzi 1989; Massironi 1998; see also Verstegen 2005).

We aim to contribute to the idea that the relation between art and science is the source of a great deal of inspiration for both sides by focusing on a research topic that we have been working on in laboratory research over the last 15 years, i.e. the key role of opposites in human perception (see Bianchi & Savardi 2008a). By now, it has been sufficiently well established in empirical studies and theoretical models on the cognitive organization of space that space is phenomenally shaped along opposite dimensions (e.g. Bianchi, Burro et al. 2013; Bianchi, Savardi & Burro 2011; Bianchi, Savardi & Kubovy 2011; Gardenfors 2000). Mirrors are particularly intriguing since they are optical devices that inevitably produce spatial variations perceived as oppositions (Bianchi & Savardi 2009). In this paper we will develop this idea and suggest that the creative manipulations shown in artworks making use of mirrors often concern playing up (accentuating or adding) or weakening (attenuating or denying) the perceptual contrarieties exhibited in mirror reflections. To make this point clear, we are not going to study a few cases in great detail but will rather "flash" on a number of examples which demonstrate different instances of this manipulation.

1. Preliminary Historical Notes

In order to better understand the framework of this contribution, it may be of interest to start with a few historical notes on the interconnections between

GESTALT THEORY
© 2014 (ISSN 0170-057 X)
Vol. 36, No.3, 209-226

Italian neo-Gestalt psychologists and their apparently "peripheral" interest in art. Certainly many people are familiar with Kanizsa's fundamental contribution to the study of perceptual organization (Kanizsa 1979), while probably fewer people know of the personal research he carried out in art from the sixties to the end of his life. His interest led to the production of more than 200 pictures and paintings (see the Historical Archives of Italian Psychology, http://www.archiviapsychologica.org/index.php?id=1298).

In addition to Gaetano Kanizsa, many of his no less influential assistants and students shared with him a genuine interest in art. Paolo Bozzi, for instance, a brilliant scholar in the field of visual and acoustic perception, made contributions to music as a composer and to literature with his book, *Fisica ingenua* [Naïve physics], one of the most exciting autobiographies in terms of literary style and narrative ability.

Manfredo Massironi is surely another genuine example of a visual scientist who all through his life approached art using the same epistemic style and the same heuristics that he used in his experimental work on visual perception (e.g. Deregowski, Parker & Massironi 1994; Massironi 2001; Massironi & Bressanelli 2002; Massironi & Bruno 1997; Massironi & Savardi 1991). After studying Industrial Design and Architecture[1], Massironi participated in the foundation and development of the *Gruppo ENNE*, which significantly contributed to the "Programmed and Kinetic Art" movement (also called "exact art" or "Gestaltic art") at the end of the fifties in the context of the European Avant Garde. In Padua, where Vittorio Benussi had founded the Institute of Experimental Psychology (thanks initially to Cesare Musatti and later to Fabio Metelli), Massironi and the *Gruppo ENNE* devoted many years to the study of the perception of shape and space in parallel with the studies being carried out in the university laboratories of Padua and Trieste. Later on, Massironi dedicated himself to laboratory research on visual perception and university teaching (initially at Rome University and later at Verona University). This is the theoretical and cultural context within which the authors of this contribution have been trained. Massironi's artworks, in particular, will join us in the following pages.

2. Exploring the Visual Structure of Reflections Inside a Laboratory and Outside

Various studies have been carried out in Experimental Psychology on what people see in mirrors and what people expect reflections to do (e.g. Bertamini, Spooner et al. 2003; Bertamini, Lawson et al. 2010; Bianchi & Savardi 2008b, 2012; Croucher, Bertamini et al. 2002; Savardi, Bianchi et al. 2010; Takano & Tanaka 2007). But many types of reflective surfaces have also been *represented*[2] and *used*

[1] See Bianchi & Savardi (eds) (2007).

[2] The painting *An Interior, with a Woman refusing a Glass of Wine*, (attr. Ludolph de Jongh, 1660-5) is a quite

in art. Both these sources can help us understand the perceptual experience of mirror reflections and enable us to analyse the idea suggested at the beginning of this paper, i.e. that artworks which play with mirrors often accentuate (or add) or attenuate (or deny) the elements of contrariety that characterize the relationship perceived between what is in front of the mirror and its reflection. Two points need to be clear to understand this claim.

1) When we recognize something as a *reflection* (i.e. as the mirror image *of something else*), various factors concur: the chromatic characteristics of the surface; the presence of a frame; the incongruity between what we then see within the frame and the characteristics of the surroundings and so on. Among these factors, an important aspect is recognizing *a correspondence* between two items that are not identified as independent, individual items, but are linked by a special relation of identity (Bianchi & Savardi 2009). This correspondence can be *directly perceived* in some cases or *discovered by means of cognitive or motor activity* in others. A legitimate question concerns the critical cues for this correspondence to be recognized.

2) The original object and its reflection are opposite in space both in terms of localization with respect to the mirror and in terms of orientation. In fact, with respect to an external frame of reference (allocentric space), a reflection is always *localized* opposite, e.g. over/under, on the right of/on the left of, or in front of/behind it, depending on where the mirror is set with respect to the original object. In addition, the reflection is also *oriented* opposite with respect to the original object along the axis which is orthogonal to the mirror. For example, in the case of a person or object facing a mirror set vertically, when the person/object faces north, the reflection faces south. In the case of a person or object standing upright with a reflecting surface placed horizontally on the floor or on the ceiling, the person/object is oriented in an upright position while the reflection is upside-down. These elements of contrariety which characterize the relation perceived between the orientation of an object and of its reflection with respect to an external frame of reference are more or less evident depending on the structure of the object. In the case of a sphere, for example (see Fig. 1), the opposite orientation of the reflection is less visible than if the object has an intrinsic orientation. With a shoe, not only is this opposition evident, but a further element of opposition is also revealed relating to the object's intrinsic frame of reference: the right shoe becomes the left shoe in the reflection. And if instead of a shoe we look at a person, the person's right hand becomes their left hand in the reflection. For an extended description of this oppositional geometry and the experimental findings on the evidence of identity and opposition in various types of mirror reflections, we direct the reader to Bianchi & Savardi, 2008b, 2009; Savardi, Bianchi & Bertamini, 2010.

rich collection of reflections in an interior: in the mirror on the wall, in the alabaster vases, in the water jug, in the marble floor, in the candelabra (http://www.nationalgallery.org.uk/paintings).

Fig 1 Objects with various symmetrical-asymmetrical structures in front of a plane mirror.

These are elements of opposition that necessarily characterize any mirror reflection. Further contrarieties may be added to these: if, for instance, a mirror is convex or concave, it enlarges or reduces (homogeneously or otherwise) width, height or both height and width, thus determining changes in size and shape. Art can operate on these variables and add even more transformations, thus "manipulating" the correspondence between an object and its reflection perceived by the observer. In the following pages we will present various examples of manipulations involving mirrors which have been carried out in art and in displays of objects or people. We will briefly discuss a) how these manipulations can be structurally described in terms of accentuating or attenuating the elements of opposition experienced between the two objects and b) what this suggests in terms of the impact of various transformations on our ability to recognize that what we see is a reflection.

We will focus on the contrasts in colour, shape, size, orientation and localization exhibited in artworks and discuss their perceptual outcomes in relation to findings which have emerged from laboratory evidence. Scientific literature on the subject offers a further means to help us understand what makes the visual structure of these artworks intriguing. In any case, art itself has the potential to suggest new aspects worth looking at and investigating experimentally.

2.1. Correspondence of Colour and Shape

To our knowledge, there have been no specific laboratory investigations on the impact of variously severe alterations in colour and shape on the ability of humans to recognize that what they see is a reflection. Conversely, art is a rich source of insights into this subject. We see that an invariance in colour plays a role in facilitating an immediate recognition of something as a reflection, but it is probably not essential. The same holds for shape, although the surprise and wonder that we experience when looking at deforming mirrors reveals that – beyond certain thresholds – recognizing identity between a reflection and the object/person reflected is not intuitive; it requires, and in fact spontaneously activates, testing strategies. In most of the cases that we are going to consider (except the last), the reflections shown in the artworks are visibly opposite to the original person/object in terms of both localization and orientation – i.e. the artwork does not operate on these elements of opposition. What it does is add further contrasts.

Let us start with *The girl before the mirror* by Picasso (1932) (http://www.moma.org/collection/object.php?object_id=78311). We expect to see an invariance in colour and shape between the girl *in front of* the mirror and her reflection. However, there are instead notable variations relating to various aspects: we expect the *same colours* but we see *different colours*; *textured surfaces* correspond to *homogeneously coloured* surfaces and vice versa; *aligned* elements correspond to elements which are misaligned. But despite all these local violations, we can still recognize that what is shown on the right of the painting is the reflection of the girl (with an opposite sagittal orientation) standing on the left in front of the mirror.

Another interesting work that stimulates us to consider how violating the correspondence of shapes influences our recognition of a scene as a reflection is Jeppe Hein's mirror *Cuts* 2011 (Fig. 2). The slashes in the foil on the mirror (mirror foil on aluminium frame) produce a ripple effect near the cut which only alters the shape of the reflection *in that circumscribed region*. The artwork provokes us to focus on the impact of deformations involving parts of the image on the overall perception of invariance: in this specific case, the deformation transforms *continuous* contours into *broken* contours. We still recognize that we are looking at a reflection. In other artworks the violation of form is more severe and makes the recognition of identity harder. An example of this is Anish Kapoor's non-plane mirrors (e.g. *Magic mirrors*, 2009; S-*Shaped mirror*, 2006) which severely deform the overall shape of the objects/people in the environment which are reflected in the mirror. Here the difference in shape generates surprise and pushes the observer to activate strategies (mainly using motion) to *see* the correspondence and find its rules.

Fig 2 Jeppe Hein, *Left Diagonal Cut*, 2011 and *Right Diagonal Cut,* 2011 (Courtesy: Johann König, Berlin and 303 Gallery, New York; Photo by Roman März).

The examples discussed thus far *add* further contrasts to those of localization and orientation which are usually exhibited in reflections and are preserved in these artworks too. A different case is shown in Massironi's *Struttura ottico-visiva a cilindri* (*Visual optic structure of cylinders*, 1964; Fig. 3). The base is formed of *straight parallel* steel wires. The light generates multiple reflections in *curved* patterns which we see on both the inside and outside surfaces of the cylinders. Here the violation of the expected shape consists of transforming something *straight* into something *curved*, turning *parallel* lines into a play of motifs made of concentric *converging/diverging* lines. But there are no cues in the reflected pattern relating to an "opposite orientation" with respect to the shapes which are reflected. These are chromatically homogeneous lines, and thus, as in the case of the sphere shown in Fig. 1, they give no visible clues to the front-back inversion in the reflection. One really needs to do some cognitive work to dig up the correspondence (i.e. the perception of invariance) between the reflected motifs and the straight parallel lines from which they originate.

Fig 3 Manfredo Massironi, *Visual optic structure of cylinders* (1964).

There are other examples in art of how the correspondence of shapes or colours can be manipulated stimulating us to also think about the correspondence between *front and back*. When we see something from behind, and a mirror shows us the frontal view of that image (which is occluded from our observation point), we expect to see a frontal view which "corresponds" to the back view. This somehow involves amodal completion. In this case too laboratory evidence is still to be sought, whereas interesting evidence comes from art. Consider for example Ernst Ludwig Kirchner, *Toilette – Frau vor dem Spiegel* (*Woman before a mirror*, 1913-1920) – a detail (adapted) of this painting is shown in Fig. 4, on the left. In this painting the expected correspondence between back and front is disregarded and we are surprised by the reflection: the woman has her arms *raised* and her hands *behind* her head while in the reflection her shoulders droop and her right hand (the left hand of the reflected woman) is *in front* of her face. This violation of the "shape" of the figure is due to local alterations in the position of various parts of the woman's body in space, involving up-down and front-back dimensions. It disturbs us and prevents us from immediately accepting that what we are looking at is really the reflection of the woman before the mirror.

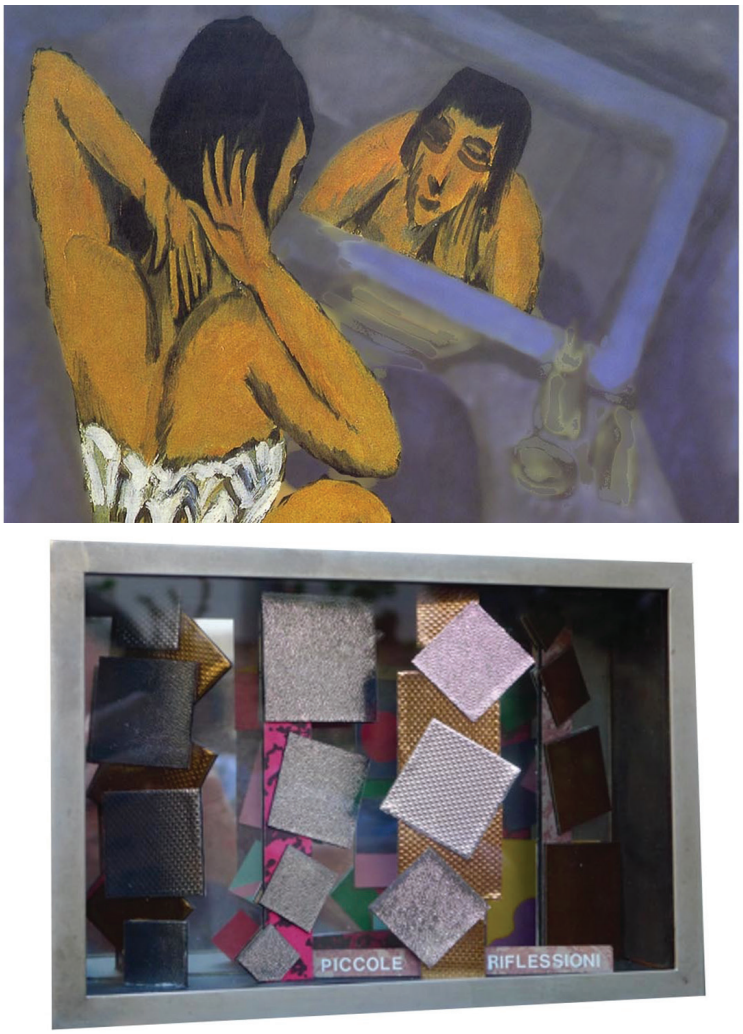

Fig 4 Above: Detail (adapted) from Kirchner´s *Toilette - Frau vor dem Spiegel* (1912) (original painting: http://www.centrepompidou.fr/). Beneath: Massironi, *Piccole riflessioni* (*Little reflections*, 1971).

This lack of correspondence between front and back is "the key" to Massironi's *Piccole riflessioni* (*Little reflections*, 1971) - Fig. 4, on the right. Here the violation concerns colour. We are initially inclined to seek the "little reflections" suggested in the title in the little silvery and golden reflective squares in the *foreground*. Then we discover that we cannot see any reflections in them, and that what we are really being invited to observe by the artist is what appears in the mirror which forms the *background* of the box. We see *coloured patterns* in this mirror and this makes us rethink things (i.e. we need to "reflect" a little) in order to understand where

these reflections come from. We cannot directly see the back of the little fake mirrors at the front. It is this reverse side which is reflected in the mirror but since it is very different from the front view (which is of a *homogeneous grey*) we need to perform a cognitive reconstruction in order to understand what we are seeing.

2. 2. Correspondence of Size

We know from laboratory studies that people are usually inaccurate when they either predict or visually estimate the size of a reflection on the surface of a mirror and also when they estimate how the size of the reflection will vary as the distance of the observer increases or decreases (Bertamini & Parks 2005; Lawson & Bertamini 2006; Lawson, Bertamini & Liu 2007). Most people, however, are accurate when they are asked to start from a reflection and judge the size of the corresponding real object/person (Higashiyama, Shimono et al. 2005).
But what happens when we look at a reflection that does not correspond in size? Does this lack of correspondence compromise our recognition that what we see is a reflection? Informal observations from everyday experience and evidence in art confirm that correspondence in size might facilitate recognition of a reflection, but it is not an essential cue. We may feel a bit surprised when we look into magnifying mirrors which increase the size of our face or when we see ourselves reflected much smaller than our real size in reflecting apps in I-phones but we still recognize our own reflection. Our reactions to artworks that manipulate this variable seem to support this intuition. In Fig. 5, an adapted version of the painting *Beethoven* by Felice Casorati (1928) is shown together with 2 variations obtained by manipulating the size of the reflection of the child. We may wish to discuss which version appears the most correct to us, but in none of the versions does any lack of perfect correspondence in terms of size compromise our acknowledgement that we are looking at a child and her reflection.

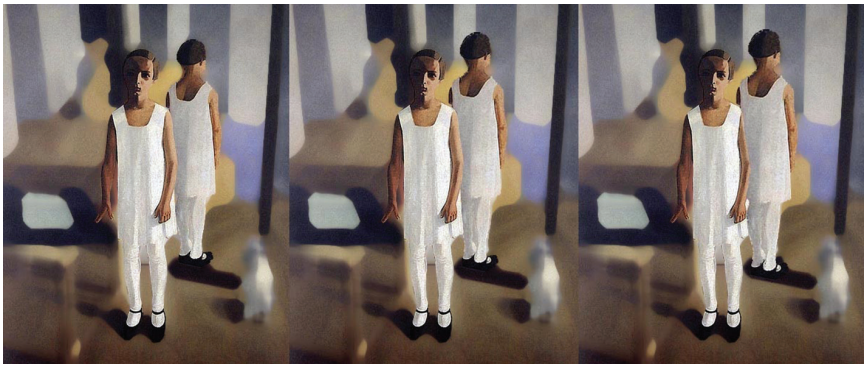

Fig 5 Three variations in the size of the reflected girl (adapted from the original painting by Felice Casorati, *Beethoven*, 1928, http://www.mart.tn.it/collections.jsp?ID_LINK=688&area=137&id_context=3395). The size of the original painting is the first on the left.

Does the same hold when the reflection is a great deal bigger or much smaller than the original? To answer this question we can cite examples from artworks where this alteration is taken to the extremes. For example, in the tapestry of *The Lady and the Unicorn* (which illustrates "Sight", 15th century; Fig. 6, on the left) the unicorn is reflected in a small mirror held by a lady. The reflection is *much smaller* than it should be but this does not prevent us from recognizing it as a reflection. Similarly, in Daniel Rozin's *Wooden mirror* (1999; Fig. 6, on the right) the reflection is *greatly enlarged* and still recognizable as a reflection. In this latter case observers normally use movement to substantiate their initial impression (as can be seen in this video: http://www.youtube.com/watch?v=1ZPJ0U_kpNg).
In conclusion, evidence in laboratories and in artworks suggests that variations in size (within a range to be experimentally defined but probably quite large) do not compromise the recognition of something as a reflection. In some cases the violation goes unnoticed and in other cases it is taken to the extreme and becomes a noticeable violation which, even if it surprises us, does not compromise perceptual or cognitive recognition. In any case reflections are always located and oriented opposite the original object/person. But what if the location and orientation were also violated?

Fig 6 On the left: Detailfrom *The Lady and the Unicorn*, 15th century, Musée de Cluny, Paris (adapted from: http://www.musee-moyenage.fr/collection/oeuvre/la-dame-a-la-licorne.html). On the right: a person interacting with Daniel Rozin's *The wooden mirror*, 1999 (adapted from: http://www.smoothware.com/danny/woodenmirror.html).

2. 3. Correspondence of Orientation

For two decades psychologists have exclusively focused on the egocentric left-right reversal when discussing the relationship between the orientations of a reflection and its origin (Corballis 2000; Gardner 1964; Gregory 1987, 1996; Haig 1993; Ittelson 1993; Ittelson, Mowafy & Magid 1991; Morris 1993; Navon 1987; Takano 1998). More recently, it has been shown that this reversal, relating

to the intrinsic frame of reference of the original object, coexists with other elements of opposition which people notice more readily when they observe their reflection in a mirror (Bianchi & Savardi 2008b; Savardi, Bianchi et al. 2010; Takano & Tanaka 2007). What people describe is an *opposite orientation in reflections along the axis which is orthogonal to the mirror*, whereas reflections are identically oriented with respect to the axis which is parallel to the mirror. All this is perceived with respect to an extrinsic frame of reference (allocentric space). With an asymmetrical item such as the human body, this opposition is (with frontally placed plane mirrors) already noticeable when the *sagittal* axis is reversed, but it becomes much more evident when the mirror is positioned on the floor and the *gravitational* orientation of the reflection is thus reversed. In this latter case the reflection is perceived to be contrary (upside-down) with respect to the original object/person (Savardi & Bianchi 2008). Let's now leave laboratory evidence and turn to evidence in artworks.

By denying sagittal opposition, *La reproduction interdite* by René Magritte (1937; Fig. 7 – first picture on the left) makes us aware of its importance in normal reflections in plane mirrors set vertically on the wall. In this famous painting, the reflection *is not reversed front-back* as a real reflection would be. We see both the back view of the man facing the mirror and the reflection of his *back*. The violation of the sagittal reversal *(back-front)* seriously compromises our willingness to accept that what we see is a reflection. We might also wonder whether an additional manipulation of the size of the reflected man would lead in this case to the same effects (discussed earlier) in situations where sagittal opposition is not denied but preserved (fig. 5).

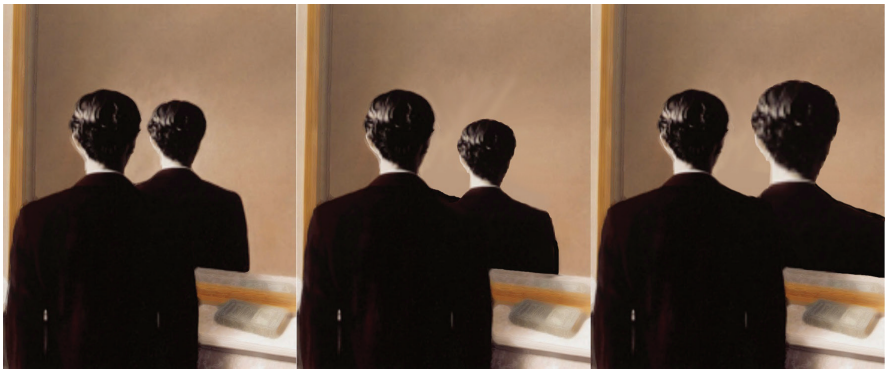

Fig. 7 René Magritte, *La reproduction interdite* (adapted from: http://collectie.boijmans.nl/en/collection/2939-%28mk%29) and two variations in the size of the reflected man. The size of the reflection in the original painting is the first on the left.

The gravitational reversal of orientation embedded in the visual structure of reflections is exhibited, for example, in Jeppe Hein's *Mirror Floor* (2011) and

Anish Kapoor's *Sky mirrors (2010)* – see Fig. 8. In these cases the transformation of the identity of the original object/person which the piece of art exhibits is precisely the type of opposition that mirrors per se show and observers, as we know from laboratory studies, notice this opposition and describe it as such. Hence the reflection is perceived as being contrary to the original object/person. The artist makes this violation of the invariance which is normally expected in reflections visible to observers, enhances their awareness of it and thus uses this violation to convey a message.

Fig 8 People observing the effect of the upside-down transformation exhibited in Jeppe Hein's *Mirror Floor* (2011; Courtsey: Johann König, Berlin and 303 Gallery, New York; Photo by Anders Sune Berg), on the left, and in one of Anish Kapoor's *Sky Mirror* (2010; adapted from http://www.trendhunter.com/trends/anish-kapoor-sky-mirror), on the right.

2. 4. Correspondence of Localization

Various laboratory studies have proven that people have quite imprecise knowledge of *where* reflections in plane mirrors will appear in correspondence to the original object and of how they will move in a reflection. They expect the reflection to be slightly rotated with respect to how it really is (Muelenz, Hecht et al. 2010) and in a significant percentage of cases (20 to 50% depending on the task) they expect the reflection to be positioned and to move along unrealistic trajectories, e.g. they expect a person entering a room and moving parallel to a mirror surface to see their reflection appear at the farther edge (with respect to themselves) of the mirror rather than the nearer edge (Bertamini, Spooner et al. 2003); Savardi, Bianchi et al. (2010) found the same phenomenon when movements at various angles of incidence were considered.

People also imagine that a reflection will show parts of the surrounding environment which realistically they would not be able to see. For example, if an observer is placed at quite a distance to the side of a mirror's edge, people still expect this observer to see more or less what they would see if placed in front of the mirror in a central position (Bertamini, Lawson et al. 2010; Bianchi &

Savardi 2012). The remaining percentage of people who make correct predictions for eccentric viewpoints, stating that the part of the surrounding space which fits into the mirror shifts to the opposite side with respect to the observation point, in the great majority of cases expect this shift to be much less wide than it really is (i.e. they manifest a "frontal bias").

Further evidence that people find it difficult to localize the position of a reflection correctly is also present in a number of famous paintings involving someone (Venus or a lady) gazing into a mirror (Bertamini, Latto et al. 2003). The face in the mirror is often located incorrectly in these paintings (e.g. Hans von Aachen, *Couple with Mirror*, 1596; Simon Vouet, *Toilet of Venus*, c1628; Titian, *Venus with a Mirror*, 1555; Velázquez, *The Toilet of Venus*, 1*647-1651*) but observers seem to be happy with this artistic license. Notice that, however, this incorrect localization often co-varies with the correct opposite sagittal orientation. We might wonder what the effect would be (in terms of how easy it would be to recognize that what we see is a reflection) if we altered both of these aspects. This is something that is still to be tested experimentally.

Another interesting artwork that helps us to understand the difficulties people have with the correspondence between the localization of objects in the world outside and inside a mirror, given various angles of inclination, is Massironi's *Cubo luminoso e struttura dinamica* (Luminous cube and dynamic structure, 1961) – Fig. 9. Inside a wooden box with transparent sides, Massironi placed nine vertical pins, each holding three separate coplanar mirrors. The pins can be rotated by the observer: by positioning the mirrors at various inclinations, new spatial compositions are created inside the box. These correspond to the external environment in a way that is perfectly predictable in terms of optics. However, the geometry involved in the correspondence between the *single* space which is reflected and the *multiple* reflections seen inside the box (some of which are reflections of reflections) is too complex for most observers. In reflections of reflections, the usual relationships that hold between the orientation of the original object and its reflection are altered: some oppositions remain but others do not.

Fig 9 Massironi, *Cubo luminoso e struttura dinamica* (Luminous cube and dynamic structure, 1961).

2. 5. What Happens when the Correspondence between the Original Object and its Reflection is Hidden and can only be Discovered by Looking "Inside" a Mirror?

This analysis of the structure of reflections started with the statement that recognizing the correspondence between two items (an object and its reflection) is an important aspect of our acceptance that we are looking at a reflection and we lose confidence if we don't find this correspondence. We then explored some aspects of this correspondence. But what if we don't see any correspondence? There are various artworks that might be used to exemplify this last condition, but we will refer to another of Massironi's artworks, entitled *Fotoriflessione variabile* (Variable photoreflection, 1962) – Fig. 10. Here Massironi catches the observer totally off guard.

We see a black wooden box with a square plane mirror on the front. The surrounding environment is reflected normally in this mirror. If we then turn the machinery on (pressing a switch in the electrical version of the artwork or moving two switches in the mechanical version), we see a virtual world on the other side of the mirror which has nothing to do with the real world on our side of the mirror. We see a fascinating play of floating fan-shaped patterns of light in motion, creating a space which curves off into infinity, and we start to wonder how this moving pattern of lights is created. We have the impression that these nine identical fan-shaped patterns which move simultaneously are reflections. But the mirror in front of us is immobile while all this movement is going on

and we cannot see anything in front of the mirror which corresponds to the reflection. There are no lights and certainly no illuminated floating fans. The source of the phenomena is in fact hidden behind the apparent mirror: inside the box there are nine lights which are reflected in two rotating mirrors plus a mirror foil which are the true reflecting surfaces. But this is hard to understand unless we dismantle the box. By cancelling one of the two terms of the relationship (i.e. the original object to be reflected), Massironi compromises the rules relating to reflections and it is thus hard for observers to accept that what they see is a reflection.

Fig 10 Manfredo Massironi, *Fotoriflessione variabile* (Variable photoreflection, 1962) switched off (on the left) and switched on (on the right). For a further description of the artwork, see text.

Conclusion

We started by acknowledging that the result of this paper would merely be to encourage further explorations of this relationship between art and science with specific reference to mirror images. There was no intention to exhaust the topic. However, it seems to us that some aspects of this relationship have been sufficiently exemplified in these pages.

Mirrors are special objects in our everyday world: embedded in the visual experience of reflections, a fundamental aspect which models human knowledge is revealed, i.e. the dimension connecting identity to contrariety and opposition. Mirror images would simply be photographs if they did not embody the intriguing relationship which makes some of their elements opposite to their corresponding pieces in the outside world.

We have shown how, even though each starts from different methodological premises and each uses different tools, experimental research on the phenomenological structures of perception and artistic research both additively

or subtractively operationalize (in terms of identity-opposition) the phenomenal features of objects reflected in a mirror such as shape, colour, dimension, localization and orientation.

Summary

This paper aims to contribute to the idea that the relationship between art and science is fundamental to research into the visual structure of mirror reflections. The purpose of the paper is to argue that a) both art and laboratory studies enable us to explore the perceptual constraints underlying the recognition of a scene as "a reflection"; b) research on the experience of reflections is closely linked to research on the experience of space and c) the various different ways of representing and using reflections in art are based on the recognition and manipulation (attenuation or accentuation) of visible relationships of identity and opposition between objects represented in space.

Keywords: Mirror reflections, identity-contrariety, perceiving opposites, opposites in art, art and science.

Zusammenfassung

Dieser Beitrag unterstützt die Ansicht, dass die Beziehung zwischen Kunst und Wissenschaft zur Erforschung der visuellen Struktur von Spiegelbildern von grundlegender Bedeutung ist. Die Arbeit soll zeigen, dass a) sowohl Kunst als auch Laboruntersuchungen uns in die Lage versetzen, die Wahrnehmungsgrenzen, die dem Erkennen einer Szene als "Spiegelbild" zu Grunde liegen, zu untersuchen; b) Forschung zur Erfahrung von Spiegelungen eng verbunden ist mit Forschung zur Raumerfahrung; und c) dass die vielen verschiedenen Darstellungsweisen und Verwendungen von Spiegelungen in der Kunst auf dem Erkennen und der Manipulation (Abschwächung oder Hervorhebung) sichtbarer Beziehungen von Gleichheit und Gegensätzlichkeit zwischen Objekten, die im Raum dargestellt sind, aufbauen.

Schlüsselwörter: Spiegelreflexionen, Identität- Widerspruch, wahrnehmbare Gegensätze, Gegensätze in der Kunst, Kunst und Wissenschaft.

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