Foreword - On the Meaning of Visual Meanings

1. On Visual Meanings

In order to introduce this second volume of the special issue dedicated to The Place of Meaning in Perception, some of the main issues of the complex relation between visual objects and meanings will be put forward here. This will be accomplished through a phenomenological approach and in the spirit of Gestalt Psychology.

1.1. What is This?

When we talk about meanings we usually refer to what is intended, what is expressed or what is indicated. This is a simple definition common to most vocabularies. Implicit and preceding this definition is the question "what is this?" Phenomenally, the most immediate and natural way to express what we are seeing and perceiving is to name it: naming something can be considered the simplest way to indicate and express its meaning. The "something" and its name are two sides of the same coin: the something is visual, while the name is linguistic. Both vision and language are mutually related both semantically and syntactically, although the kind and the nature of this function are not yet defined save in terms of denotation, i.e. of its explicit definition as listed in a dictionary, and of connotation, i.e. of the set of associations that a word usually brings to mind.

Although one of the two basic elements, the name, is quite well understood and explained through a plethora of cognitive theories, the other, i.e. the something, needs to be more deeply understood at its source. If naming something is a way to indicate and express its meaning (assumption of the correspondence between name and meaning, and between something and meaning), the elemental question to be answered is: what is the *something* that we perceive before assigning it a name? Is it the visual meaning? And what is a visual meaning?

In the next sections we will take the first steps toward exploring this complex visual topic. Further and more decisive steps will be accomplished through the collection of intriguing papers enriching this second volume of the special issue. The last questions suggest that the main issue of what a visual meaning is could be reduced to the problem of object (*thing*) formation, a matter first studied by gestalt psychologists, as shortly described in the next section.

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1.2. Object Formation: Gestalt Approach and Beyond

According to Rubin (1921), the perception of a visual object depends on the figure-ground segregation. Wertheimer (1923) investigated its complementary process, i.e. the grouping, aimed at defining how the elements in the visual field 'go together' to form a holistic percept. Some well-known general principles underlying figure-ground segregation and grouping were discovered, becoming some sort of basic grammar of vision.

In Fig. 1a, a variant of the classical Rubin's figure is illustrated. If the starting question is: "what is this?" the most common answer, at first sight, is a black cup. By watching closely through the cup shape, a new result emerges, namely two close and facing white profiles. The two figures emerge alternately and reversibly, but the cup is perceived more strongly than the profiles. The weight of the figure-ground segregation can be easily changed in favor of the profiles as shown in Fig. 1b. Now, the cup is almost or totally invisible due to the closure principle. In Fig. 1c, the strengths of the two outcomes appear more balanced. By comparing these figures freely and by judging the relative vividness of the two possible results, the profiles are likely perceived more strongly than the cup by virtue of the past experience that, according to gestalt psychologists, plays a role as an independent principle in both grouping and figure-ground segregation.

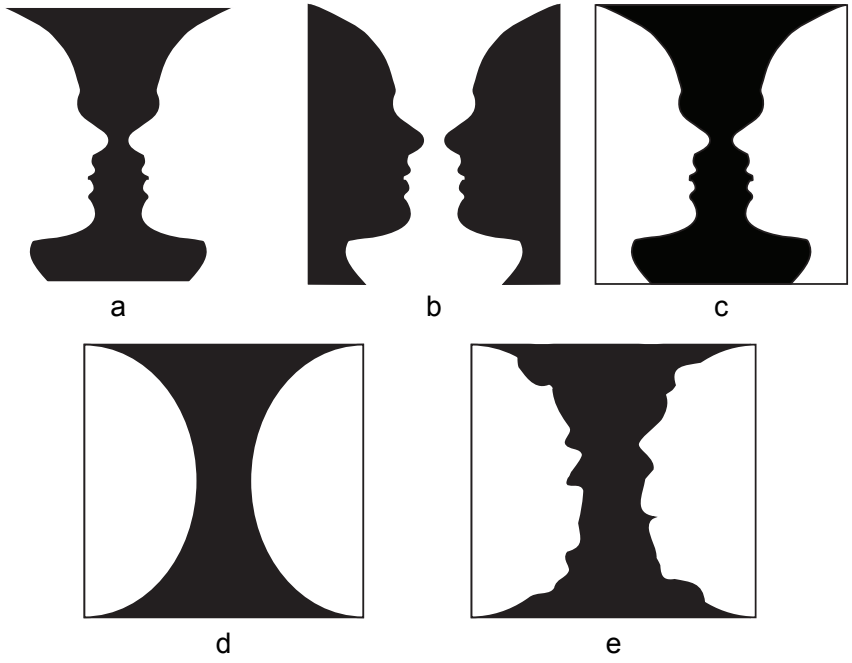

Fig. 1 Variants of the classical Rubin's figure.

Similar effects, though less spectacular, can be perceived in Figs. 1d-e, where the two conflicting outcomes are the black concave and the white convex complementary regions within the square frame. Under these conditions, the role of the past experience is clearly reduced or annulled and the two principles, now playing in competition, are convexity and proximity.

Underlying these results is one of the main phenomenal properties of the figure-ground segregation, the unilateral belongingness of the boundaries, according to which the figure takes on the shape traced by the contour, i.e. the contour belongs unilaterally to the figure, not to the background. The unilateral belongingness determines the alternation and the reversibility of the cup and the face profiles. It follows that, since every object is delimited and segregated unilaterally from the background, it can theoretically be perceived with a double complementary segregation. Nevertheless, Rubin's unilateral belongingness of the boundaries represents also a useful way to preserve the uniqueness of a visual object by inducing the alternation of the two possible outcomes when they are in equilibrium or by further enhancing the vividness and identity of the more intense outcome.

On the basis of the previous phenomenal results, the answer to the question "what is this?" represents a first challenge for a theory of visual meaning. In fact, it is two-sided and conflicting: cup or profiles? More generally, naming something can be problematic for identifying a visual meaning, not only because of the ambivalent and reversible outcomes, but also because one of them can be partially invisible here and now or invisible only for a short time, then it can come to the fore. Therefore, naming what it is is just a partial way of defining things and visual meanings, although it is necessary. Starting from these remarks, the following general statements, considered as main issues of the complex relation between visual objects and meaning, can be drawn.

One object, many things (una res, mille imagines). Starting from the same pattern of stimuli, i.e. from the same geometrical something, more than one phenomenal thing can emerge. The asymmetries in strength create hierarchical organizations and a complex gradient of visibility (see Pinna, 2010a, 2010b) that can change in real time, for example, when the cryptic camouflage is induced or suddenly broken/discovered (see the dramatic changes of the octopus mimicry). Cryptic camouflage (Edmunds, 1974; Poulton, 1890; Ruxton et al., 2004; Wallace, 1889) is the kind of concealment involving form and coloration and mostly ruled by the gestalt principles of visual organization, which allows an organism to avoid detection and predation by blending into the environment and by becoming effectively imperceptible.

From this statement, the next one follows. *If one of the possible things or instances emerges, then all the others become "invisible", pushed into the background.* When

they have about the same strength, they alternately and reversibly compete to emerge and to define the gradient of visibility. If one thing overcomes in vividness the other, it becomes immediately visible, making the other invisible. More generally, only one tends to be prominent and visible while the other is pushed into the background. On the basis of this statement, the object uniqueness and identity is maintained, i.e. preserved from showing more than one possible instantiation, visual meaning or appearance.

This statement represents an object identity/meaning push-pull dynamic, according to which what is visible here and now makes it difficult for the observer to perceive other possible identities and meanings. In other words, the perception of one thing, considered as a possible identity of an object, induces blindness in other possible identities. Uniqueness and identity are ruled according to a "winner takes all" principle. In the next section, we will see that the same statements govern also the inner dynamics at the root of the perception of the square shape.

The previous statements are corroborated by the results of Fig. 2-left, where the face of the Italian artist, Mario Mariotti, is almost invisible or hardly identifiable, being split in six funny faces painted on it, which pop out with vividness. They impose their appearance and, at the same time, induce blindness with respect to the artist's face. The deception is revealed in Fig. 2-right where the whole figure is vertically rotated and the artist's face now becomes the new emergent identity. The funny faces disappear as such and appear only like painted small faces upon a real face.

The results of Fig. 2 are not related to figure-ground segregation in a strict sense, but to a more general process of thing and visual meaning formation, where the figure-ground segregation is only one specific instance among many others. In the next sections, different conditions will be described.

Fig. 2 Funny faces and Mariotti's face.

In spite of their effectiveness in accounting for the phenomenal results of the previous figures, the gestalt principles of figure-ground segregation and grouping cannot be considered like the basic grammar of the language of vision, namely like the whole system and structure of this language comprising syntax and semantics. Actually, they are related only to the figure-ground segregation and to the grouping processes, and their purpose is not to explain the visual meanings. In the next section, the inner complexity of the matters related to the meaning of visual meanings will be shown by analyzing phenomenologically a singular object that can be considered as the limiting case of all the possible ones: the square.

2. What Do We Mean When We Say "a Square"? Towards a Visual Semantics

In order to investigate what we mean when we say "a square", a mental experiment can be useful. When we think of a square, we picture the shape of a square of a certain size and oriented according to the main directions of space, namely with vertical and horizontal sides. The square of our mental exercise is likely similar to the one illustrated in Fig. 3a.

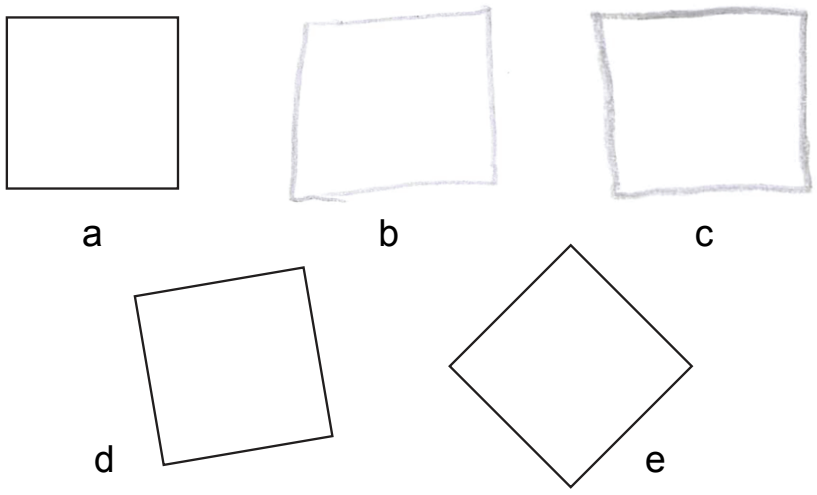

Fig. 3 Squares, a rotated square and a diamond.

When a group of 30 subjects, ranging from 6-7 year old children to adults (undergraduate students), was asked to "draw a square", they took a pencil and drew a square shape as illustrated in the two examples of Figs. 3b-c. When a new group of subjects was randomly shown Figs. 3b-c, the answer to the question "what is this?" was "a square".

It is worth noticing that next to what emerges during the spontaneous descriptions and drawings, there is also what is not described or drawn. It can be equally important for the understanding of what is a square and, more generally, of the phenomenology of its inner organization. As a matter of fact, none of the subjects drew squares like the shapes illustrated in Figs. 3d-e. In fact, when asked "what are they?" the subjects answered respectively "a rotated square" and "a diamond". What is surprising is that Figs. 3b-c with clear "imperfections" along the perimeters, though the shapes are not perfect squares, appear more like squares than the rotated square and the diamond of Figs. 3d-e. This result suggests that, in order to be a square, the vertical and horizontal orientation of the sides, though not perfectly straight, is more important than the global rotations shown in Figs. 3d-e, even if the sides do not show any imperfection. This conclusion is corroborated by the descriptions of Figs. 3b-c, where the imperfections and the space orientation of the square were totally omitted, but clearly reported in the case of Figs. 3d-e.

Moreover, by saying "a rotated square", subjects clearly perceive the figure both as a square and as something different from a "true" square, i.e. from the square as it should be in the "right" orientation with vertical/horizontal sides (Pinna, 2012a, 2012b, 2012c). Finally, the diamond appears as a shape with a meaning different from the square (Pinna, 2010a, 2010b, 2012c). These results occur in spite of the fact that all of these figures are geometrically squares. This implies that from a geometrical point of view the meaning of a square is different from the phenomenological one. This point will be elaborated in the next section.

2.1. On the Meaning of the Square

The square is likely the most fundamental of all shapes. Geometrically, it is entirely based on the balanced proportion between its edges/sides and angles/vertices. The next arguments are aimed at demonstrating that, phenomenally, the balanced proportion is not true at all.

On the basis of the previous mental experiment, the meaning of the square is related to the orientation of the sides along the main directions of the space. This entails that the squareness is not the absolute proportion between sides and vertices but the prominence of the sides upon the vertices. This is likely due to the special roles assumed by the sides of the square. Among them the most important role belongs to the lower horizontal side (the base of the square) that induces stability and flatness in the square. In addition, the word "square" evokes terms like straight, level, parallel, steady, equal, smooth, unchanging, plane, constant, stable, uniform and flat. The name itself, i.e. "base", demonstrates its role as the foundation of the square, the component where the square rests. The importance of the base in assigning the meaning to the square is corroborated by the fact that

the upper horizontal side has no peculiar name and that both the vertical sides can become the height of the square reinforcing the special phenomenal role of the base.

The comparisons between the square and the diamond and between the squareness and the diamondness are likely the best phenomenal ways to investigate the inner properties of the square and, consequently, to understand the meaning of the square, what a square is. The square rotated by 45° that appears as a diamond, i.e. as a new shape different from the square, corroborates once more the asymmetrical and unbalanced roles of sides and vertices. While the square is perceived and imagined as flat and stable, the diamond is seen as sharp and unstable. The two figures reveal opposite meanings. This is why they are perceived as two different objects and, likely, why they need two different names. This phenomenological analysis demonstrates something counterintuitive on the basis of the geometrical definition of square: the two main components, sides and angles, are not perfectly balanced, in fact the former are more prominent than the vertices. The opposite occurs in the case of the diamond.

The side emergence can be called "sidedness" and reveals mostly the attributes previously mentioned. On the contrary, in the case of the diamond, the stronger sharpness, belonging to the angles and vertices, oriented along the main direction of space, reveals the prominence of what we call "pointedness". It is not by chance that the term vertex etymologically comes from the Latin word *vertere* that is "to turn" and "straight up and down" meaning the point opposite the base, the highest point or the turning point. The orientation of the square and of the diamond along the main directions of the space enhances only one of the two opposite properties of these shapes, i.e. the sidedness or the pointedness.

In conclusion, the meaning of the square is defined by the inner asymmetric dynamics between sidedness and pointedness and emerges as such on the basis of the sidedness that wins against the pointedness. The meaning of the diamond depends on the same dynamics, but with a more salient and vivid pointedness than sidedness.

As in the case of the cup and profiles described in Fig. 1, the meaning of the square depends on the contrast and asymmetry between antagonistic things. However, differently from the cup and the profiles, these antagonistic things are now inner attributes both involved in the square formation, not figures segregated from the background. What emerges at the end is the square, not the sidedness. By changing the equilibrium between the two attributes, for example as will be shown in the next section, the whole meaning changes and the square becomes a diamond or *vice versa*.

In the case of the rotated square, the sidedness remains prominent and the perception of the orientation, as an emergent meaning, represents a way to

discount the pointedness. This happens paradoxically by emphasizing its perception and by including it in the description, by saying that the square is rotated. In other words, only through the perception of the rotation, i.e. of something that is not part of a "true" square, can the perception of the square be restored. The different meanings among square, rotated square and diamond and the unstable equilibrium between sidedness and pointedness can be demonstrated by accentuating sides or vertices as shown in the conditions illustrated in the next section.

2.2. Squares, Rotated Squares and Diamonds by Accentuation

The accentuation principle was first demonstrated by Pinna & Sirigu (2011) in conditions like those illustrated in Fig. 4, where the filled circle is perceived like an accent falling on a specific element within a context of elements and emphasizing a particular location within the whole shape, i.e. the vertex and the side respectively, and therefore the pointedness and the sidedness. More specifically, the pointedness is highlighted in Fig. 4-left, where the accent on the top vertex polarizes the directions of the elements and emphasizes the whole diamond shape. By changing the position of the accent to the side, as shown in Fig. 4 right, the sidedness is now stressed and the shape is described as a square rotated by 45°. This corroborates the conclusions of the previous section, according to which squares rotated by 45° and diamonds, although geometrically equivalent, are phenomenally two different figures. This is due to the opposite properties in the foreground, i.e. sidedness and pointedness, induced by the accentuation and, under these conditions, playing against the main directions of space (see also Pinna, 2012c).

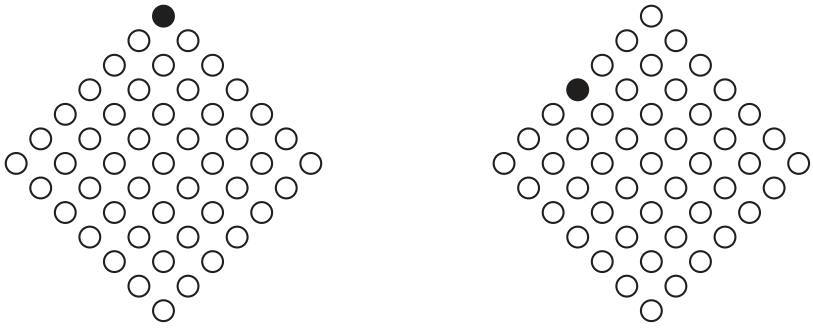

Fig. 4 A diamond and a rotated square from accentuation of pointedness and sidedness.

In Fig. 5, despite the configural orientation effect (i.e. the perception of local spatial orientation determined by the global spatial orientational structure)

studied by Attneave (1968) and Palmer (1980), the two rows of figures are perceived as rotated squares or diamonds according to the position of the small circle placed near the sides or the angles (see also Pinna, 2010a, 2010b; Pinna & Albertazzi, 2011).

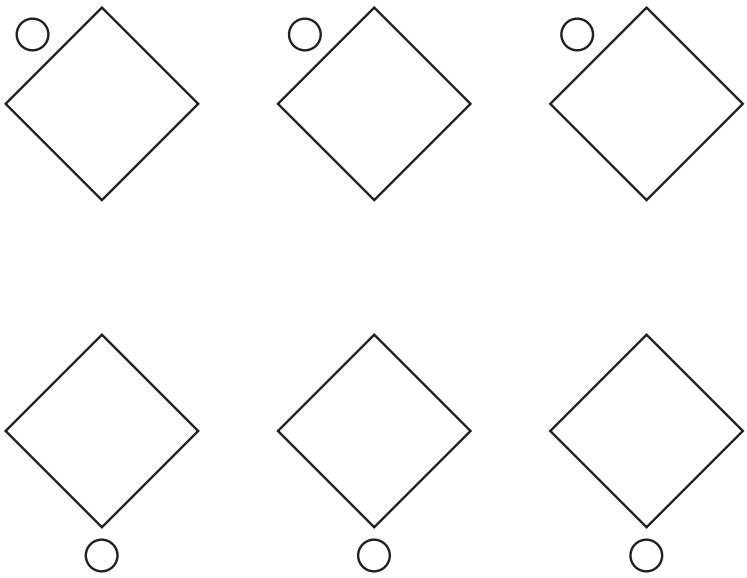

Fig. 5 Rotated square and diamonds from accentuation of sidedness and pointedness.

The previous figures and, more specifically, the conjunction between the small circle and the geometrical diamonds demonstrate a new kind of perceptual organization, which is not grouping in the acceptation used by gestalt psychologists. Beyond what is expected on the basis of the grouping principles, each small circle becomes a whole with each figure and both create a unity. They are not simply grouped by proximity, similarity or other gestalt principles, but are to be regarded as two elements that, although distinct, interact creating a unity and influencing one another in their orientation, position, etc. As a consequence, the small circle, by highlighting inner attributes, contributes to defining the meaning of the object (it being a rotated square or diamond).

This unity/wholeness organization is supported by the fact that the accentuation principle manifests a long-range effect. In Fig. 6, the accent, placed in the central component, spreads its action on the other elements all around (sidedness on Fig. 6a and pointedness on Fig. 6b). As a consequence, in Fig. 6a the elements are perceived as rotated squares, while in Fig. 6b as diamonds. It is worth underlining that the condition with rotated squares (Fig. 6a) is totally unexpected on the basis of the configural orientation effect.

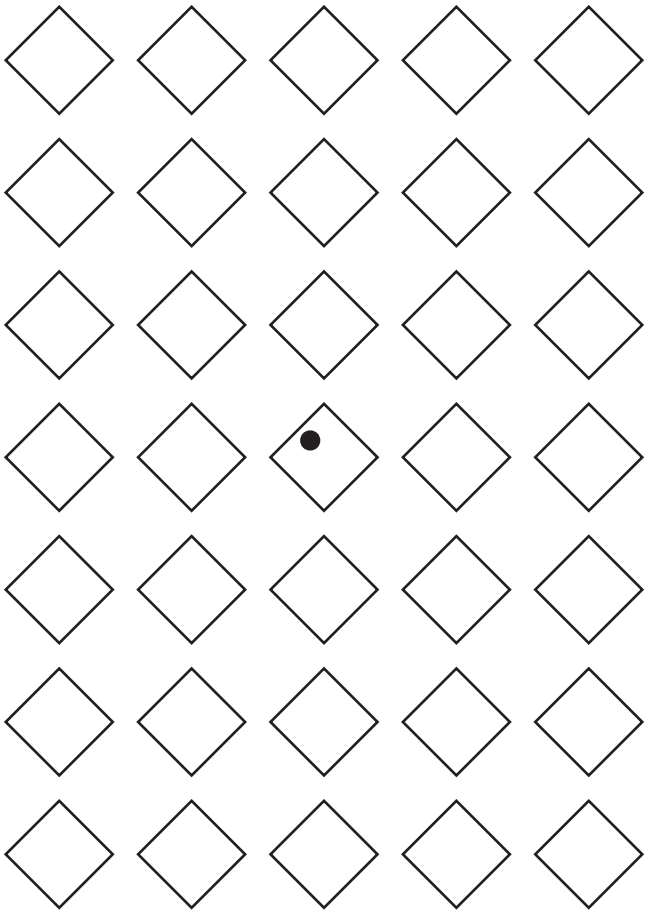

Fig. 6a Rotated squares.

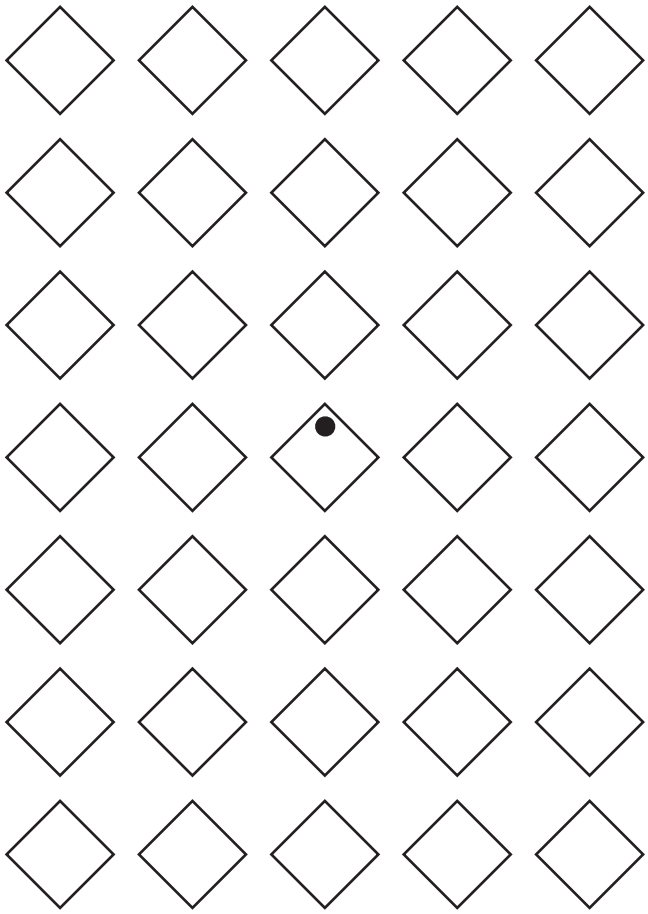

Fig. 6b Diamonds.

The unification of dot and shape and the whole formation, eliciting different visual meanings and objects, as demonstrated in Figs. 4-6, occur also within a large circle, where apparently there is nothing to accentuate, i.e. no sides or vertices. However, the accentuation due to the dot together with the unification of the dot and the circle orients and polarizes the circular shape by imparting to it a precise direction. The circles of Fig. 7 clearly appear polarized differently and in the direction of the dot.

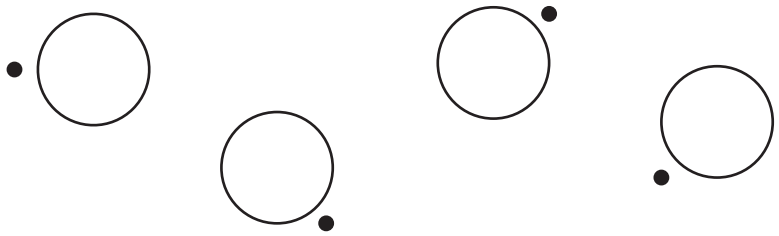

Fig. 7 Oriented and polarized circles.

In Fig. 8, this kind of organization is demonstrated by showing that the accent determines the direction of the apparent rolling of the circles. More specifically, the circles are perceived to roll in the direction accentuated by each dot.

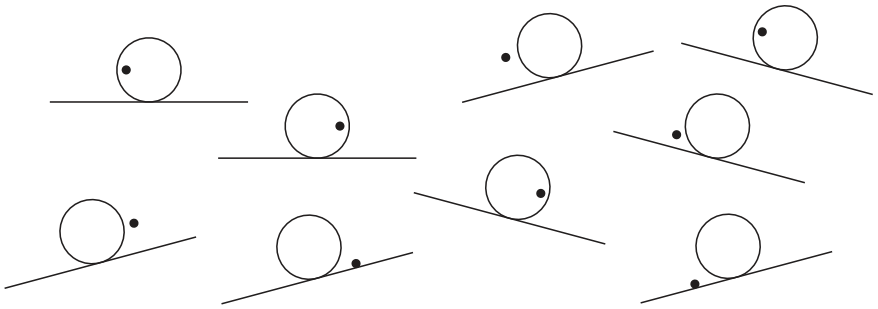

Fig. 8 The accent determines the direction of the apparent rolling of the circles.

The results of the last conditions show that each single portion of the circle can be accentuated, thus creating polarized circles and, as a consequence, a new meaning for each circle. Given that a circle is the set of points in a plane that are equidistant from a given point (the center), this means that along the circle, geometrically, there is no privileged point that defines a specific direction of the overall shape: the circle should be in perfect equilibrium. The results of Figs. 7-8 suggest that the meaning of the circle, in terms of its direction, depends on the dynamics occurring in the inner location, dynamics that can be easily changed or highlighted to reveal many different kinds of circles. They are all circles but they are polarized in different directions, hence they are different circles. A more dramatic shape change can be obtained with irregular shapes as shown in Fig. 9. The accentuation of irregular quadrilaterals involves not only sidedness and pointedness, but also different kinds (amplitudes) of vertices, whose accentuation can totally change the whole shape, i.e. the overall object meaning. In other words, the accent can modify and distort the shape more dramatically than the previous

ones (rotated squares or diamonds) as demonstrated in Fig. 9, where the rows of irregular quadrilaterals are perceived as different shapes, difficult to recognize as being the same geometrical figure. This suggests that when we see a shape and, more generally, a meaning, we perceive the shape/meaning most prominent and emerging among a set of possible different shapes related to the multiplicity of inner attributes. The related general statement posits that *the meaning perceived is only one instance among many possible ones competing to emerge and creating the gradient of visibility*, i.e. what is real here and now is only a question of perception of one among many.

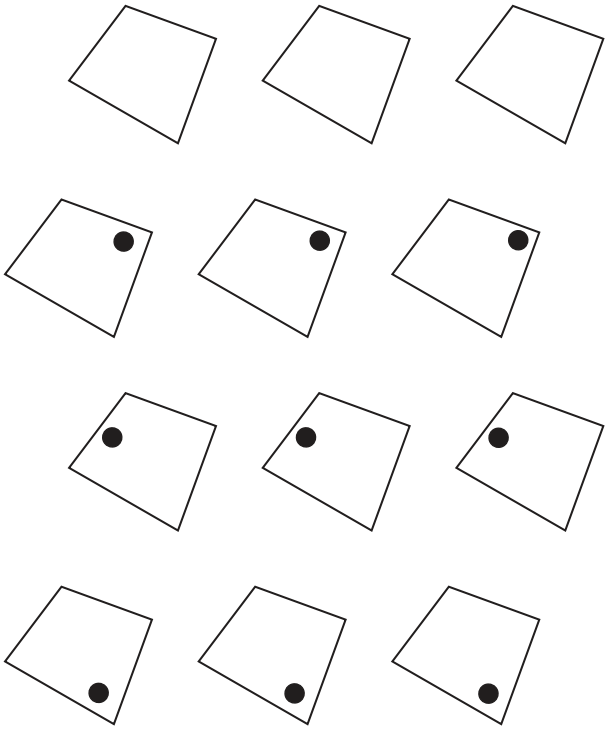

Fig. 9 The rows of irregular quadrilaterals are perceived as different shapes, difficult to recognize as being the same geometrical figure.

The accentuation principle is at the root of the disruptive camouflage (Cott, 1940; Cuthill et al., 2005; Merilaita & Lind, 2006), which is the antithesis of the cryptic camouflage and is aimed at confusing the individual organism with high contrast colorations and markings, which disguise form and shape. These markings are quite distinctive and prevent the observer from accurately identifying shape, size, orientation, and number of individuals within a group. Related to the disruptive camouflage, there are other kinds of camouflage more

phenomenally related to the accentuation and very similar to Mariotti's face. In Fig. 10, false eyes, dots (diematic patterns) are geared to confuse by showing a disruptive masking and deceiving shape and, at the same time, to hide the most important part of the body. The same defensive markings can also have the effect of startling or frightening predators. It is worth noticing that the direction (anterior and posterior) and organization of the fish body, illustrated in Fig. 10, appear reversed due to the dot near the tail.

Fig. 10 Disruptive camouflage due to accentuation.

These kinds of disrupting and deceiving accentuations are likely supposed to play simultaneously different biological roles. The same patterns of markings take on totally different meanings to conspecifics, e.g. by emphasizing and determining a clear sexual dimorphism, by becoming sources of sexual attraction, by advertising the presence and eliciting species identification/communication. More generally, the same disruptive and deceiving patterns are simultaneously aimed at showing/hiding according to the following list that assigns specific meanings in relation to a particular species: showing the whole, a part, some parts more clearly than others, something that would be otherwise invisible, parts that are not natural, fragments; showing in order to hide; showing to break and split, to separate, to multiply; showing the uniqueness, some elements, some more or less important elements, something and not showing something else; showing some parts and not the whole. On the basis of these arguments, it is very likely that fish, insects or birds, both predators and prey, are subject to these illusions of meaning induced by the accentuation principle.

Altogether these results demonstrate the following statement: *the accentuation within a geometrical object of a specific location and of an inner attribute is a remarkable way of defining the visual meaning of the overall object*; *this meaning is only one among many (una res, mille imagines)*. In the next section some new ways of creating meanings will be demonstrated.

2.3. The Illusion of Meaning: What is Real is Only a Question of Perception

Another way to understand the meaning of the square and to explore the complexity of the formation of visual meanings, different from the accentuation of specific inner locations/attributes with black dots, is to introduce discontinuities along the shape as shown in Fig. 11a. Despite the fact that good continuation, *prägnanz* and closure principles put together all the sides of the shape to form a pentagon, the most prominent phenomenal result is "a beveled square", where the beveling is not a "word" of the vocabulary belonging to the form of grouping. In terms of grouping there is neither a "square", nor a "beveling" or an "a". The "a beveled square" is the outcome of a different kind of perceptual organization related to meaning formation, i.e. the form of meaning (Pinna, 2010a), through which a complex set of reciprocally-related meanings emerges. Similar illusions of meaning can be perceived in Figs. 11b-d.

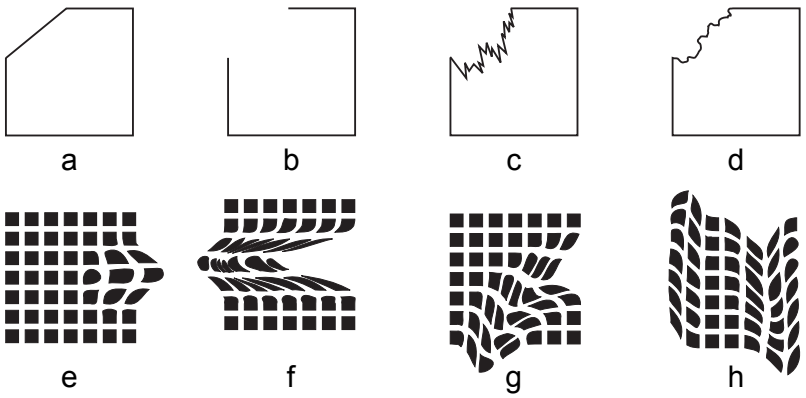

Fig. 11 Illusions of meaning.

Without the perception of meanings we would have perceived only elements grouped and ungrouped in a holistic percept. This is phenomenally very far from the richness of the meanings with their complex net similar to a language but, as we will see, much richer than the spoken language.

The meaning of the beveling is perceived as the result of an action which happened to the figure (the happening, see Pinna, 2010a), making it appear incomplete and

irregular. Nevertheless, without the beveling, the figure would have been complete and perceived as a square. This suggests that the beveling makes the figure appear incomplete and irregular and, at the same time, complete and regular. This is a paradox easily solved as follows: the two antinomies are perceived as placed at different phenomenal levels, i.e. due to the beveling the figure appears incomplete at one phenomenal level to appear complete at another level of perception. One level is related to the other, that is one is perceived provided the other is perceived. This kind of visual organization cannot be explained without invoking the formation of visual meanings.

The nature of these meanings is supported by the fact that one emergent object/meaning is the square phenomenally considered like the subject of the phenomenal proposition, i.e. like the "noun", that refers to a thing and denotes what is described by the "predicate" or like the term of the perceptual "sentence", about which something is affirmed or denied. Differently, the beveling can be considered like a doing word, i.e. something that occurs to the square, so that without it the square would have been complete. It follows that the beveling is like a visual "predicate" or like a perceptual "verb" of the sentence expressing properties, existence, action or occurrence of the subject, the square.

There are some doing-meanings that, although clearly perceived, no univocal words can describe, being difficult to put into words (nameless meanings). This is the case of some of the conditions illustrated in Figs. 11e-h. These illusions of meaning suggest that the visual language precedes the spoken language and is much richer than it, i.e. the perceptual language sees many "things" that the spoken language cannot describe.

The following statements, based on the beveled square, summarize the inner dynamics of meaning formation related to the pointedness and sidedness but now referring to the relationships of homogeneity and discontinuity among the inner components. *The perceptual meanings* (square and beveling) *emerge from what is homogeneous, uniform and continuous* (the sides of the square) *and are related to a change or a discontinuity (*the oblique segment corresponding to the beveling*) within the homogeneity of element components.* To perceive the beveling, the discontinuities should therefore be maximized: *an emergent meaning is the result of an operation of maximization of changes and differences within the stimulus*. This implies phenomenal segregation and dissimilation of components and parts at different perceptual levels.

On the other hand, at the same time but at another perceptual level, to perceive the square the discontinuities should be minimized: *a perceptual meaning emerges as a result of an operation of minimization of changes and differences within the stimulus*. This implies a phenomenal integration and unification (oneness formation) of different components and parts emerging from the maximization operation.

The two previous statements represent the two terms of the antinomy, which is solved as proposed in the next statement. *The opposite operations of maximization and minimization do not annul but complement each other thus creating two different perceptual levels*. In other words, the maximally homogeneous elements, resulting from the minimization operation, become the amodal object (the square) and, thus, the background from which the maximally heterogeneous element (the beveling) modally emerges.

Phenomenally, this entails that the heterogeneous elements appear as changes (happenings) within the homogenous elements appearing as the whole. On the basis of the complementation operation two perceptual levels are systemically created, amodal (homogeneous) and modal (heterogeneous), according to which the meaning of one depends on the meaning of the other so that one cannot be perceived without the other.

The operations described in the previous statement represent possible rules of a visual semantics, but they do not say anything about the syntax necessary to understand the language of vision. A first introductory step is suggested in the next section through the phenomenological approach as used by Gestalt psychologists.

3. Shape and Color of the Square: Towards the Visual Syntax

To make good phenomenology, we consider it important to understand not only what is perceived at first sight and with the maximum strength, but also what is seen as secondary, in the background and even what is totally invisible. For the understanding of the visual objects, these secondary and invisible components can be even more important than what is immediately perceived.

The implicit/invisible outcome of the previous mental experiment and of the descriptions of the square is that none of the subjects reported the color of the square. When a new group of children was asked: What is the color of the square of fig. 3a? The answer was: "The square is white". When it was suggested: "Is this a black square?" the answer was immediate: "It is a white square, not a black square". This question is related to the fact that the color of the square is theoretically composed by the color of the inner surface of the square and/or by the color of the boundary contours. Nevertheless, only the former assumes the status of color. A further implicit/invisible attribute is the color of the background never reported during the experiment. Only, when it was asked: "what is the color around the square?" The answer was white, empty, or both. These results lead to the following general statements.

3.1. The Visual Syntax of "a Square"

The first statement for this section is: *Color can be implicit, unnoticed or totally invisible, shape cannot.* Going back to the previous figure, it clearly emerges that

all the descriptions start from the shapes and mostly end with the shapes. Their color tends to be spontaneously omitted.

Second statement: *The color is defined after the shape*, namely *the shape precedes the color*. This is clearly supported by the fact that the shape normally comes first. This general statement can also be demonstrated through the linguistic phenomenology and, more specifically, through the asymmetry between these expressions: "the color of a shape" and "the shape of a color". According to a linguistic phenomenology, the shape cannot be the shape of a color. It sounds wrong and weird at the same time. However, from a logical point of view they are equivalent and both right. Nevertheless, phenomenally the former is real and correct, the latter strange and incorrect. The phenomenal asymmetry between "the color of a shape" and "the shape of a color" demonstrates the primary role of the shape against the color. The phenomenal hierarchical organization between shape and color can be considered as the perceptual basis of the linguistic syntactic organization of the different roles/classes of noun and adjective. The shape becomes the noun, while the color becomes the adjective. The color is the 'describing' word that qualifies (noun modifier) the shape, that is the noun, i.e. the 'content' word. The syntax of visual attributes can be defined as the arrangement of object attributes (e.g. shape and color) to create well-formed phenomenal attribute organizations.

Third statement: *The color of the boundary contours is phenomenologically different from the one of the inner surface, i.e. the two colors assume different roles.* Given that the color of the inner area of the square is white, while the color of its perimeter is black, the two colors appear like different attributes of the object and are used independently: the former as the color of the object, the latter as the boundary contour of the object.

From the previous statement, the fourth one follows: *the boundary contours define the shape of an object, not its color*. A phenomenological corollary of this statement is that, *because the color of the boundary contours is not the color of the object, it is invisible in terms of color but visible in terms of boundary or shape of the object.*

Fifth and final statement: *The color of the background goes unnoticed, being implicit and invisible*. This is related to one of the basic Rubin's figure-ground segregation properties, according to which, while the figure shows a surface color/brightness property with solid and epiphanous chromatic paste, the background is perceived diaphanous as a void. All these general statements are fully supported by the results of the task "draw a white square".

4. The Place of Meaning in Perception

In the previous sections we demonstrated that next to figure-ground segregation and grouping, as proposed by Gestalt psychologists, there are other kinds of

perceptual organization related to the formation of visual meanings and to the hierarchical structure of object attributes, such as shape and color, that represent a true visual syntax. Through the phenomenological approach and in the spirit of Gestalt psychologists, we made the first steps regarding this complex visual topic by exploring old and new issues and proposing several general statements.

Further and more decisive steps will be accomplished through the intriguing collection of scientific papers comprising the second volume of this special issue, whose purpose is to explore in depth both the semantics and the syntax of vision and, more specifically, to answer the questions "what is a visual object?" and "what is the place of meaning in perception?"

The paper by *David Rose*, starting from the basic question "What is meaning?" argues that there is no single mechanism, and hence no simple answer or definition. After a full exploration of the theories developed in analytic philosophy and cognitive science, he suggests that the three conceptual axes of psychosemantics need to be recognized. They are i) atomism-holism, ii) synchronic-diachronic functionality, and iii) level of analysis.

Fiorenza Toccafondi analyzes the great themes of the Gestalt tradition and the fundamental issue of seeing the meanings in Wittgenstein and Köhler. She demonstrates that Köhler's approach, deeply and correctly reconsidered, is far different from the simplistic one attributed to him through Wittgenstein.

The work by *Peterson, Cacciamani, Mojica & Sanguinetti* investigates experimentally whether the meaning of the object that loses the figure-ground competition, due to the unilateral belongingness of the boundaries, is activated in a fast pass of processing prior to figure assignment. The results indicate that the meaning of well-known objects, suggested but not perceived on the ground side of a figure, is indeed accessed (but not suppressed) prior to figure assignment. More generally, they show that meaning is not secondary, as suggested by Gestalt psychologists, but primary.

Herzog, Otto, Boi & Ogmen demonstrate that, on the basis of a paradigm developed by Ternus and Pikler, feature processing and integration, such as Vernier offsets, are determined by global Gestalt rather than by local low-level mechanisms. Their findings support the theory of cortical visual computations as a highly distributed and interactive non-retinotopic system, rather than a strict feed-forward retinotopic hierarchy.

The paper by *Nicholas Wade* focuses on artists as practitioners of perception and great precursors of Gestalt psychology. He shows that figure-ground ambiguities and grouping principles can be seen in Roman mosaics and in works by graphic artists of several centuries ago. Furthermore, he traces a distinction between these practitioners of perceptual organization and their interpretations by Gestalt psychologists.

Martins, Rodrigues and *du Buf* present in their paper a biologically based model for the extraction of low-level semantic information, conceived as local gist in contrast to the concept of global gist that requires recognition of a full scene. While the global gist influences object recognition top down, the local gist system biases object recognition bottom up. By focusing on simple geometrical shapes (squares, rectangles, trapeziums, triangles, circles and ellipses), they show that such shapes can be detected by a hierarchy of a few cell layers, with strictly bottom-up or data-driven processing. Their model is pre-attentive and can compute such information in parallel.

The work by *Shovman, Scott-Brown, Szymkowiak & Bown* studies the problem of meaning formation in the area of Visual Analytics. Novel experimental data, based on 'pop-out' paradigm to trend detection in a 3D scatterplot, show how the context of graph perception offers a unique pathway to the view of meaning in abstract structures and corroborates the Reverse Hierarchy Theory.

Grossberg & Pinna extend brain design principles and neural networks, as described in Grossberg's FACADE, 3D LAMINART, ART, and ARTSCAN neural models, to explain a high number of visual percepts related to the three main kinds of perceptual organization: grouping, shape and meaning.

In conclusion, the semantics and syntax of vision, as deeply studied and proposed in the 2 Vols. of this special issue, suggest possible answers to the questions "what is a visual object?" "what is a visual meaning?" and "what is the place of meaning in perception?" and propose interesting approaches and plausible explanations, based on experimental data and phenomenological observations, of the complexity of the language of vision. Moreover, they can be considered as important steps aimed at the understanding of the complex connections, as yet largely unexplored, between vision and spoken language.

Students, scholars and scientists in vision and cognitive science, interested in exploring and understanding the place of meaning in perception from a multiplicity of perspectives, will find great stimulation in the papers of this and the previous special issue. Have a good reading.

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