2
Illusions that We Should Have (but Don't)

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Introduction

Illusions have been much studied in psychology and cognitive neuroscience. In addition, they continue to intrigue and amuse scientists and laymen. But what exactly are "illusions"? What is their use in the study of perception? Why are we fascinated by illusions? In this chapter I attempt to provide a novel answer to these questions. I will start by considering two extreme views, attempts to understand illusions by categorization, and the common sense view that illusions are perceptual mistakes. Next, I will propose a definition of illusions as perceptual inconsistencies. While this definition is based on phenomenological analysis, I suggest that it also has psycho-physical implications. By studying the relationship between perceptual and stimulus inconsistency, we can learn a great deal about perception, not only about its intriguing inconsistencies that we call illusions, but also – and most importantly – about its adaptive function of providing us with a behaviorally useful representation of the external environment.

Two extreme views

Defining what constitutes an illusion is not straightforward (Schwarz, 2011 this book). This has led several theoretical traditions to suggest that the very notion of perceptual illusion is useless. In one such extreme view (Gibson, 1979), for all practical uses, illusions don't exist. In real-world situations, stimulus information is sufficient to specify the properties of the environment that are relevant to us (O'Reagan and Nöe, 2001; Stoffregen and Bardy, 2001). What we term illusions corresponds to relatively rare, artifactual-degenerate stimulus conditions, and the corresponding percepts are illusions that we have, but *might not* have if more information were introduced to the situation. Thus, the notion of illusion cannot be invoked to refute a radically realistic stance. In another extreme view, all perception is, in a sense, illusory. According to constructivistic theories of perception – such as the Gestaltist and the neo-Helmholtzian (Koffka, 1935; Rock, 1987) – percepts are generated by the brain's creative construction. For this reason, all percepts are created equal. There are no illusions or veridical percepts – there are only phenomena to be explained on their own terms.

Both extreme views imply that the very notion of perceptual illusion is useless, because it does not pinpoint an interesting problem in cognition. I find this implication unsatisfactory for two reasons. The first is related to the (potentially circular) problem of defining what would constitute adequate information in a given situation. Real-life conditions – whereby abundant stimulus information fails to correctly specify environmental properties – are less rare than one may think (Bressan et al., 2003; Shimamura and Prinzmetal, 1999). Rather than trying to define exactly what is adequate information and what is not, one may try to understand what differs between such natural conditions and other, more frequent, natural conditions that result in correct specification of environmental properties. Such an exercise may give us important insights to the adaptive functions of perception. The second reason for dissatisfaction is that illusions have wide-spread use in vision science and have enduring appeal as images. Consider Table 2.1, comparing Google searches for the term "illusions" with conjoint searches adding the adjectives "optical", "visual", or "perceptual", in 2004 and 2006. Web sites devoted to illusions are myriad. They range from resources for vision scientists, to popular science sites for teachers and the general public, to more or less amateurish collections in personal pages. Interest is huge, continues to increase, and poses a problem in itself. Are all these pages about nothing? What are they referring to?

Table 2.1 The enduring appeal of illusions, as seen in web pages

Goggle™ search term	Hits Jan. 2004	Hits Sept. 2006
Perceptual illusions	24,000	929,000
Visual illusions	191,000	2,990,000
Optical illusions	291,000	6,620,000
Illusions	1,770,000	24,300,000

Taxonomic efforts and their shortcomings

Enduring appeal can have many causes. One is that we are often fascinated by things we don't understand. Consider the well known family of the so-called optical-geometrical illusions, which account for the majority of images available on the web. For a few of these phenomena we now have explanations. For instance, many well-known illusions involve interactions between lines at different orientations (see for instance Figure 2.1a). There are reasons to believe that such effects are accounted for by interactions between orientation-sensitive neural units early in visual processing (Ninio and Pinna, 2006).

For many other optical geometrical illusions, however, explanations are still wanting or remain problematic. The Müller-Lyer illusion (Figure 2.1b), for instance, has been ascribed to a misapplied size constancy mechanism (Gregory, 1966). Consider objects in the real world and their retinal projections, and recall that equal retinal sizes can correspond to large objects far away, or small objects near the viewpoint. This means that, to obtain an object's real size, the visual system cannot use simply the available retinal size, but must scale retinal size by apparent distance. Now, assume that the Müller-Lyer patterns are interpreted as local cues to a three-dimensional structure. If this assumption holds, then the segment surrounded by outward-pointing arrows is nearer, and hence smaller. However, the explanation requires that the arrows be interpreted as cues to a 3D structure. Variations such as the

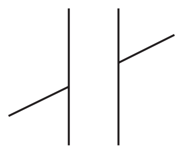

Figure 2.1(a) The Poggendorf illusion

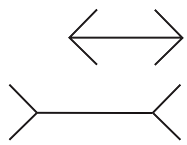

Figure 2.1(b) The Müller-Lyer illusion

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"dumbbell" version of the figure (Figure 2.1c) clearly demonstrate that this is not necessary. Thus the basis of the Müller-Lyer illusion remains unknown, as is the case for many other "optical geometrical" illusions.

Given these difficulties, it is perhaps not surprising that many attempts to understand perceptual illusions have been limited to taxonomies. Gregory (1997; Ninio, 1998) classified illusions by crossing four types – ambiguities, distortions, paradoxes, and fictions – with four causes, or "origins" – physical, physiological, top-down interpretations, and collateral rules.

Behind these taxonomic efforts is the idea that illusions come in different kinds, so that conceptual tools suited for one kind may not be equally useful for others. Thus, illusions that originate in physics may be best understood in terms of optics and the generation of a specific stimulus pattern to a viewpoint. Mirages, rainbows, or indeed bent oars in water are supposedly examples of such kinds of illusions. Illusions that originate in a visual system's physiology are best understood by the operation of neural mechanisms, such as the lateral interactions that account for the Hermann grid (Spillman and Levine, 1971). Illusions due to top-down rules are accounted for by internalized knowledge, as when a shaded pattern flips from bump to dimple in accordance with the assumption that the light should come from above (Ramachandran, 1988). And so on. These approaches propose a taxonomy to "look up" the appropriate explanatory device to a given type of illusory percept – a sort of periodic table. A general theory, it is hoped, should follow.

But does it? Identifying the right "cause" for a given type of percept is itself problematic. Consider Kanizsa's famous illusory triangle (Figure 2.1d), which Gregory classified as an instance of "fiction" arising from the application of top-down interpretations. Such illusory figures are usually produced using line drawings. Despite Gregory's term, however, it is not hard to build a non-fictitious object that will be perceived as an "illusory" figure. Several years ago, I built one to study moving Kanizsa triangles (Bruno and Gerbino, 1991). It consisted of

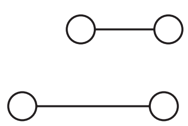

Figure 2.1(c) The "dumbbell" version of the Müller-Lyer illusion

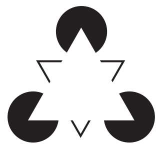

Figure 2.1(d) Kanizsa's triangle

a triangle made of black cardboard, mounted on the shaft of a rotor. The shaft passed through a hole in a larger surface – also made of black cardboard, with white strips on it. Under appropriately low and diffuse illumination, there was a clear luminance difference between the dark surface and the coarse white texture, but no luminance difference between the front triangle and the background – both being the same black cardboard.

But, of course, observers perceived an illusory Kanizsa triangle; that is, they saw borders where there was no luminance gradient, and a lighter foreground surface despite the same luminance on the figure and the ground. The only difference was that the triangle was not a fiction: it was there, although the conditions of illumination and the choice of materials removed some information about its borders. Some information, but not all. The pattern of occlusion of the textured background – due to the presence of the figure – was not removed. And indeed observers proved able to use that spatiotemporal pattern (the "inducers" of the "illusory" figure) to reconstruct the border of the triangle.

So why do we see a figure in these conditions? Invoking top-down interpretations, as opposed to optics and physiology, remains vague. Rather, one would seem to need a more articulated explanatory strategy, combining functional, algorithmic, and structural considerations. At the functional level, optical and biological concepts are needed to understand how natural images may underspecify the borders of objects, how certain organisms may exploit the physical characteristics of their niche to hide from predators (mimetic animals), and how other organisms may try to discover where they hide (border reconstruction in perception). At the algorithmic level, one needs mathematical and logical tools to model the processes that reconstruct borders from sparse information. At the structural level, finally, one needs physiological data about the neural mechanisms that implement the reconstruction process.

The idea that perceptual explanations require coordinating more than one level or "cause" is not new (Marr, 1982). Aristotle himself clearly understood that the causes of a phenomenon could be understood in different ways. The issue of multiple levels of explanation has been subjected to interesting debates in biology (Hogan, 1994; Timbergen, 1972). Illusion taxonomies are useful to define the scope of the phenomena to be studied, but seem hardly suited to provide a satisfactory framework to understand illusions.

A third view, and three features of the moon

In a third, common sense view, illusions are simply wrong perceptions. But wrong in comparison to what? A notion of perceptual error implies that percepts may be correct, or mistaken, in relation to a psychophysical chain. Said otherwise, perception may be wrong in representing the features of either the corresponding physical object (the "distal" stimulus) or of its retinal projection (the "proximal" stimulus). Does this clarify what we term illusions? I think not. To appreciate the difficulty, let us consider three perceptual features of one of the main characters of this book, the moon. We immediately discover that error is not sufficient to define illusions, neither in relation to the distal nor in relation to the proximal stimulus. Table 2.2 above summarizes the argument. The text below illustrates it in depth.

The size of the moon. As many know, the moon appears larger near the horizon than at the zenith. One of the two perceived sizes may be considered erroneous, based on our knowledge that the moon does not change in physical size as it travels the sky during the night, or on measurements of its visual angle at the horizon and at the zenith, which is practically constant. This may be taken as in indication that we take as illusions those percepts that are wrong both in relation to the distal and the proximal stimuli. However, considering a second feature quickly shows that this is not the case.

The moon's induced motion. The moon also occasionally appears to move across the visual field when viewed against a background

Table 2.2 Three perceived features of the moon

Feature	Distal stimulus	Proximal stimulus	Percept	Illusion?
Horizon size	same as zenith	same as zenith	larger than zenith	YES
Motion	practically none	relationally fast	fast	YES
Color	very dark	very bright	very bright	NO

of clouds that move in the opposite direction, or behind sparse trees whose projections are displaced on the retina due to the observer's fast movement (for instance, in a car). The perceived motion may be considered erroneous, based on our knowledge that the physical motion of the moon along its orbit is much slower than the currently perceived motion. At the same time, it may be recognized that, in kinematics, motion is always defined relative to a frame of reference. Thus, the moving moon is, in fact, a correct description of the optical motion of the moon's retinal projection relative to the projection of the clouds or trees. The moon's induced motion is at odds with its distal counterpart, but not with its proximal description. We may conclude that the necessary condition for us to consider a percept illusory is erroneous in relation to the distal level. However, a third feature shows that this is also not the case.

The color of the moon. Finally, consider the color of the moon. As we all know, the moon is white. But is it? The stuff on the surface of the moon is made of very low-reflectance material and – as we all know – low-reflectance materials such as carbon powder are black or very dark gray. In relation to this physical characteristic, we should conclude that the color of the moon is a wrong perception. Yet, very few of us would be ready to consider the moon's whiteness an illusion. For all of us, the moon *is* white. That we don't call the moon's color an illusion is proof that even errors in relation to the distal level are not necessary conditions for "illusionhood".

Illusion as perceptual inconsistency

What is it then that we call illusion? And again, is the notion of any scientific use? I suggest that a coherent definition of illusion can be formulated, and is scientifically useful. What we term illusions are cases where perception lacks consistency in some of its features while remaining consistent in others. Consider a set of stimulus conditions S1, whereby you experience a percept P1 as referred to a certain external object O. Now suppose the stimulus conditions change to S2, and you experience a percept P2 ≠ P1, but P2 is again referred to O. For instance, you may experience a certain apparent size in reference to the moon, and note that it changes when it is at the horizon relative to when it is at the zenith. It is this change that we call illusion, but only if it is superimposed on a non-changing substratum.

Said otherwise, the perceiver must be experiencing features that are in part constant and in part variable. The constant part insures that the variable part continues to be referred to the same object. For instance, you may identify the moon as a single, persisting object based on similarity of form and color, and on its unique status as a relatively large bright object in the night sky. The variable part is therefore experienced as a perceptual inconsistency, which becomes odd and surprising precisely by virtue of its link to an otherwise constant set of object features. For instance, the moon is a persisting object in the night sky. It appears to occupy different positions in the sky depending on the time of night, but whenever we glance at it stands still. Hence we conceive of its changes in position as occurring very slowly, at speeds comparable to those of the hour arm in our watch. The sudden increase in the moon's speed when moving against the cloud is inconsistent with its usual apparent stillness, and we deem this motion illusory, although it is in fact a valid kinematic description of what is occurring on our retina.

The color of the moon, by contrast, is always consistently white. Although changes in color are occasionally reported (such as, for instance, a reddish tinge), these are slight and rare enough that most of us never notice them. Most importantly, there is simply no way for us to see the moon turn black. Hence, the whiteness of the moon is not called an illusion, even though one could argue sensibly that this is a perceptual mistake.

Three forms of perceptual inconsistency

The idea that illusions may be understood as perceptual inconsistency is not limited to the three moon illusions discussed above. To give generality to the proposal, consider three ways that perception may be inconsistent: across time within one perceptual system, between perceptual systems, or between percepts elicited by merely observing or by acting on an object.

Inconsistency across time. Perception can lack consistency within a given perceptual system over successive acts of observation. Some examples: (i) I look at the horizon moon and it looks huge. Later I look at the moon in the middle of the night sky and it looks much smaller. In fact, it stays small throughout the night. Therefore, I call the size of the horizon moon an illusion. (ii) I see Clotilde and Kevin entering the Ames's room (Ittelson, 1952). I look into the Ames's room through the peephole. I see that Clotilde is a giant and Kevin a dwarf. They trade places in the room. I now see that Clotilde is a dwarf and Kevin is a giant. They exit the room. I now see that they are about the same size. In fact, I always see them that way – except when they are in the room.

Thus I call their sizes in the room an illusion. (iii) I put my index and middle fingers on the sides of my nose. I feel my nose between my fingers. Now I cross my fingers and put them on the sides of my nose. I feel *two* noses between my fingers (Benedetti, 1986). I uncross them and I feel one nose again. In fact, I feel one nose when I touch it in any other way. Thus, I call the double nose an illusion.

Inconsistency between perceptual systems. Perception can lack consistency between perceptual systems. Some examples: (i) I put on my stereo goggles and look at a stereogram on my stereo-ready computer monitor. I see a cube floating in midair in front of the monitor. I know the cube is somehow generated by the computer, but I see it as having a real three-dimensional structure. Yet when I try to touch it I feel nothing. Thus I call the cube an illusion. (ii) I see two boxes on the table, one small and one large. I lift one with my right hand and the other with my left hand. The larger box feels lighter (Charpentier, 1891). I now close my eyes and re-lift. The boxes feel the same weight. Whenever I ignore their visual size, they feel the same weight. Thus the weight difference must be an illusion. (iii) I see a rubber replica of a hand on the table. It is being stroked by the upper arm of a two-pronged device. I feel my hand behind the table. I feel that it is being stroked. The stroking is synchronous with the visible stroking on the rubber hand. Does the felt stroking originate from the lower arm of the device? But after a while I no longer feel the stroking on my hand. Oddly, it feels as if the stroking sensation is localized on the alien rubber hand (Botvinik and Cohen, 1998). But my hand is my hand, I can feel it; it clearly is not where the rubber hand is – although it is not very far from it. I close my eyes and the stroking sensation is again localized on my own hand. The sensation on the rubber hand must have been an illusion.

Inconsistency between perception and action. Finally, perception can be inconsistent between percepts elicited while merely observing an object and percepts elicited while acting upon the object. The two percepts are typically elicited in parallel – I act on the object while observing it – or they may occur at different times. Some examples: (i) While approaching a roundabout in Eindhoven, NL, I see a sculpture depicting Penrose's "impossible" triangle (Figure 2.2a). The thing looks like a closed frame, yet the orientation of each side points in the wrong direction, such that it does not look parallel to the other two sides. As I enter the roundabout and keep turning, a different structure is revealed. I don't perceive the triangle any more. I see three segments each pointing in different directions. The closed structure was an illusion. As I go full-circle, I briefly see it again. Then it is again gone. I am the victim of an illusion, but only when looking at the sculpture from a certain viewpoint. (ii) As I enter a room in a museum I see a Patrick Hughes painting on the far wall (Figure 2.2b). It is not an interesting image: it depicts a series of half-open doors revealing a background sky through the half-openings. I walk towards the canvas, and something much more interesting happens. The doors turn! It must be an illusion, for the openings don't change. Yet they keep turning, and if I walk back and forth in front of the canvas they even change direction. I come close to the canvas and something else happens. The canvas is not flat. It is a bas relief. With some effort I determine that it is, in fact, a reverse-perspective bas relief. What is painted to stick out is constructed

Figure 2.2(a) A sculpture in Eindhoven, NL

Figure 2.2(b) *Beyond the Edge* by P. Hughes, supplemental material by N. Wade and P. Hughes (1999) 'Fooling the eyes: trompe l'oeil and reverse perspective', *Perception,* 28, 1115–19.

to lie in the back part of the structure, and vice-versa. I step back and the illusory turning reappears. (iii) I am shown a drawing of the Ponzo illusion. I see two segments against a background fan of lines diverging from bottom to top. One is near the top of the fan and it looks shorter. The other is near the bottom of the fan and it looks longer. Yet there is something odd about the difference. I fixate the right endpoint of the lower segment and try to pay attention to the corresponding endpoint of the upper segment. They seem to be aligned. I now gaze to the left and again the endpoints seem to be aligned. So if I move my eyes I seem to perceive the alignment, and yet the segments seem to have different sizes. How can that be? I move my thumb and index fingers towards the endpoints of the upper segment, as if to grasp it. Now I repeat the same action on the lower segment. I notice that the inter-digit span is the same. Thus, if I grasp the segments my hand "knows" that they are the same size (Ganel, Tanzer, and Goodale, 2008). The difference in size must be an illusion.

Inconsistency and meta-perception

Rather than trying to define illusions by comparison to corresponding stimuli, the present definition proposes that what we call illusions is a specific combination of perceptual experiences. As such, it is close in spirit to other attempts to define illusions at a phenomenological, rather than psychophysical, level. In particular, Bianchi, Savardi, and Kubovy (this book) have distilled the gist of previous phenomenological accounts into a definition of the illusory experience as "meta-perception". They argue that the critical aspect of the illusory experience lies in a perceptual loss of innocence.

Such loss of innocence occurs in two stages: the experience of two different percepts, and the consequent recognition of the potential fallibility of one's own sensory experience. The first of these is perceptual, whereas the second is a cognitive state *about perception* (meta-perceptual) that arises from combining the two percepts with a belief – that the two percepts refer to the same object. The account of Bianchi et al. also provides a possible explanation for the enduring appeal of illusions. Individuals may enjoy engaging in a sort of epistemological gamble, by exposing themselves to situations that remind them of the fallibility of the senses.

The proposal developed here is similar to that of Bianchi et al on several scores, but it differs from it in two specific points. While Bianchi et al. argue in favor of illusion as meta-perception, the notion of perceptual inconsistency proposed here remains fully at the perceptual level. In the proposal developed here, what we call illusion is the simultaneous presence in our perceptual experience of a constant and a variable part. As exemplified in a three-folded classification in the previous section, the constant part perceptually identifies a persisting object, either by tagging its spatial location, by temporal synchrony, or by a specific conjunction of persisting features. The variable part is then experienced as a perceptual inconsistency, and this is what we call an illusion. The experience of perceptual inconsistency does not exclude the possibility of an additional meta-perceptual state, and its potential epistemological implications. However, the present proposal argues that beliefs are not necessary to define illusions.

Additionally, the notion of perceptual inconsistency implies an alternative explanation for the enduring appeal of illusions. Rather than because we like epistemological gambles, we may enjoy illusions because they expose us to the dynamics of our own perceptual representations. Witnessing how percepts change during different acts of observation – within or between modalities, or as a consequence of our actions – is a bit like observing our own mind at work, controlling it in operations that are normally outside our conscious control. At a more sophisticated level, one may then understand the cognitive implications of the experience, not only in terms of one's own fallible senses, but also, at an even deeper level, of the constructive role that the mind has in generating our phenomenal world.

Perceptual inconsistency and stimulus inconsistency

This chapter argues in favor of a phenomenological definition of illusions. In this final part, however, I will suggest that this definition has psycho-physical implications. To this aim I will examine the relation between perceptual inconsistency and the inconsistency between the corresponding proximal stimuli (henceforth, stimuli tout court). Does inconsistency result from stimulus inconsistency? Indeed, we often experience two different percepts in the presence of two different stimuli. Consider some of the examples discussed earlier. When I touch my nose with the uncrossed middle and index fingers, the proprio-ceptive system informs my mind that I am touching a body location in between the fingers, and at the same time I activate receptors in the inner parts of those fingers. However, when I touch my nose after crossing my fingers, I activate receptors on the outer parts of the fingertips. When I attempt to touch a virtual cube on my stereo-ready monitor, there is a

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contradiction between vision (of a solid object at a specific location in personal space) and haptics (absence of felt solidity at the same location). Because of the peculiar geometry of Ames's distorted room, the retinal projections of Clotilde and Kevin's bodies change as they occupy different positions in the room. When I drive around the roundabout in Eindhoven, there is a contradiction between a closed-contour visual stimulus (from a specific viewpoint) and other open-contour stimuli (everywhere else on the round-about), although all are tagged to the same environmental location.

However, it is easy to show that the relationship between perceptual inconsistency and stimulus inconsistency is not a simple one. Interestingly, consistency in perception also often occurs in the presence of consistent stimuli. And, even more interestingly, *consistent* perception is often attained in the presence of inconsistent stimuli.

Inconsistent percepts can occur in the presence of stimulus conditions that are in full agreement. As mentioned previously, the retinal projection of the moon is indeed the same at the horizon and at the zenith. In the well-known phenomenon of simultaneous lightness contrast, two squares cut out of the same gray paper project the same luminance to the eye of the observer. Yet, the square surrounded by a large black square appears lighter than the square surrounded by a large white square. These situations are interesting, because they force us to reconsider the way we conceive stimulus conditions. Although the moon's retinal projection is unchanged as it travels the night sky, the stimulus context of that projection does change. It must be something about that context that is related to the inconsistent percepts. Although the luminance of the two gray squares is the same, the local ratio of their luminances to their immediate surrounds is completely different. There is ample literature providing evidence that surface color depends on luminance ratios, not absolute luminances (Gilchrist, 1994).

Even more interesting, however, is the fact that inconsistent stimulus situations can result in perfectly consistent percepts. Instances include all the phenomena that are classified as perceptual constancies. As an object moves relative to a viewpoint, its retinal projection changes in size and form. Yet, we don't typically perceive changes in the size and shape of objects as they move in front of us. When a shadow passes over a portion of the visual field, the luminances of the objects in the shadow are altered, and some of the local ratios between those luminances and their surrounds can also be altered (depending on the geometry of the shadow, and the layout of the objects). Yet we don't typically see changes in color when objects are in shadow.

Another case in point is phenomena of perceptual stabilization during our own movements. When walking in place inside a large rotating drum (the "opto-kinetic" drum – Lackner and DiZio, 2000), the retinal flow of the texture elements on the drum's inner surface is consistent with forward movement, but the proprio-ceptive signals from the legs are consistent with walking in place. Yet we perceive that we are moving forward, with the legs propelling us in that direction. In general, when we move relative to the environment, the retinal projection of everything is displaced on the retina. Yet the environment remains perceptually stable, and all objects continue to occupy the same phenomenal position.

Still another case is the phenomena of cross-modal integration. In the McGurk effect (McGurk and MacDonald, 1976), for instance, we see a video of a person mouthing "ga" in association with the sound of the syllable "ba", but hear the syllable "da". In visual-haptic size perception, if we touch an object of one size but see an object of a different size, we typically perceive a compromise between the two (Ernst and Bülthoff, 2004). Thus despite the stimulus inconsistency, a consistent percept is experienced.

Epilogue: Illusions that we should have

Cases of consistent perception in the face of inconsistent stimuli are deeply interesting, because they reveal conditions whereby perceptual inconsistency could occur, but does not. They are, in this sense, conditions that identify illusions that we should have – at least according to the simple-minded idea that perception is merely a recording of stimulus conditions. That we don't experience perceptual inconsistency under these conditions is therefore most informative about the adaptive computations that are performed by the perceptual system. The wide-spread consistency of perceptual descriptions in the face of varying stimuli – and the occasional inconsistencies that intrigue us – are all symptoms of perceptual processes that have to be that way, given our environment and our biology. As such, consistent perception with inconsistent stimuli gives us important insights into the active and multisensory nature of our perceptual processes.

In his famous introduction to Gestalt psychology, Koffka (1935) proposed that the starting point for the study of perception is to ask why things look as they do. Taken literally, he noted, this question refers to the objects of our experience regardless of their being veridical: "…this question…would apply to a world of pure illusion". However, Koffka also clearly stated that his question had a second, "cognitive" aspect:

> but the world is not such a grotesque nightmare…as a rule, things are what they look like, or otherwise expressed, their looks tell us what to do with them…. And thus arises the second aspect of our question: Why is it that our behaviour, directed as it is by objects in the behavioural environment, is, as a rule, also adapted to objects in the geographical environment? (p. 76).

I believe that the analysis of perceptual inconsistencies and of their relation to stimulus inconsistencies does just that. This analysis is useful, and heuristic, when adopting a wider functionalistic stance and focusing on the aims of perceptual processes. The illusions we might have, but do not, highlight how these processes have been shaped by our evolutionary history to give us behaviorally useful representations of the environment. The problem of illusions is thus subsumed into the wider problem of how we perceive at all (Morgan, 1996).

Note

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