The awareness of illusions

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Abstract
The paper discusses the idea that illusions reveal the presence of some error during a certain course of experiences and suggests that the awareness of the presence of an error may or may not be immediate, thereby offering a sub-classification of illusory phenomena into two classes: illusions we are immediately aware of and illusions we are not immediately aware of. On the basis of these considerations it is proposed that the awareness of undergoing an illusion might play an epistemic role in the cognitive functioning by revealing the possibility of an error to the subject, without requesting that in order to realize this possibility the subject steps out from his own experience.

Key words
Illusions, awareness, error, perception, coherence.

1. Introduction. The characterization of the notion of illusion is controversial

1.1 Difficulties with the notion of error

The number of phenomena that are described as illusions has greatly grown during the last two centuries, and research on illusions has become a fundamental component of psychological research about perception. However, the characterization of the notion of illusion is not uncontroversial. In the use made for instance by (Gregory, 1997) ‘illusion’ is an umbrella-term which includes a great variety of phenomena which are considered as systematic perceptual errors occurring during inferential processes (Gregory, 1997). Illusory phenomena are hence classified as:

- *ambiguities* (as the Necker cube, the visual effects provoked by mist or retinal rivalry)
- *distortions* (as classic geometric illusions, such as the Horizontal-Vertical illusion, but also mirages)
○ **paradoxes** (as the impossible triangle of L. S. Penrose and R. Penrose - which cannot be seen as a sensible three-dimensional figure - the so-called impossible figures and impossible objects in general. The mirror represented in Magritte’s “La reproduction interdite”, in which a character standing in front of a mirror sees his back, is equally considered a visual paradox, since it reproduces an impossible situation)

○ **fictions** (as the rainbow, the faces one can ‘see’ in the fire or galleons in the clouds, the after-images and figures such as the Kanisza triangle).

The notion of error which is employed in the classic characterization of the notion of illusion is strongly criticized by so called ‘direct’ approaches to perception (such as the ecological approach). The ecological approach to perception rejects the idea that perception is an inferential process based on internal representations and thus rejects the notion of illusion as an error (Turvey, et al., 1981).

Another aspect of the notion of error which creates some difficulties with the notion of illusions as errors is the standardly adopted characterization of errors as departures from facts or reality. Gregory too recognizes the difficulty of considering illusions as departures from reality, in view of the difficulty of defining what reality is, or of the risk of turning all perception into a massive illusion.

“It is extraordinarily hard to give a satisfactory definition of an “illusion”. It may be the departure from reality, or from truth; but how are these to be defined? As science’s accounts of reality ever more different from appearances, to say that this separation is “illusion” would have the absurd consequence of implying that almost all perceptions are
An additional argument against the reduction of illusions to departures from facts purports that the notion of error as departure from facts is not sufficient in order to distinguish veridical perception from illusions or hallucinations. This line of argument has been defended by D. Lewis in his discussion about veridical hallucinations. The problem raised by (Lewis 1980) is the one of distinguishing true cases of vision from veridical hallucinations. Veridical hallucinations are defined as a special class of hallucination that present the following particularity: they match the scene before the eyes of the perceiver, as it happens in cases of genuine seeing. (Lewis 1980) proposes the following example: let us imagine that I am the victim of a wizard’s spell; his spell causes me to hallucinate at random, but, for a lucky accident, the hallucination so caused happens to match the scene before my eyes.

Hence, the notion of error as departure from facts is not necessary and not sufficient for the characterization of illusions.

1.2 Awareness of error following or during illusions

In spite of the difficulties that the notion of error raises, it seems difficult to give away this concept in the characterization of illusory phenomena. In fact, a typical characteristic of illusory phenomena is represented by the fact that the subject who undergoes an illusion can at once or later become aware that something is wrong with his experience, in a broad sense. The two cases will be distinguished as illusions we are immediately aware of and illusions we are not immediately aware of. In the case in which
the subject is immediately aware of the illusion, the experience immediately seems or feels impossible to him, and he considers some of the components of his experience as wrong. This fact is of importance in characterizing the role that illusions might play in the cognitive functioning. In fact, the awareness that something is wrong represents an epistemological judgment about one’s own experience.

Nevertheless, the notion of error included in the characterization of illusions should be suitably modified as to make reference to violations of coherence and to the presence of discrepancies rather than to departures from facts or even to failures during an inferential process. In fact, as it will be shown through the exemplary case of proprioceptive illusions provoked by vibration, the awareness that something is wrong can be connected to the detection of a violation of coherence and the subject who becomes aware of being victim of an illusion experiences some kind of violation of coherence. The case of illusions we are immediately aware of is particularly suitable for illustrating the reactions provoked by violations of coherence and for pointing out that the awareness of the presence of a violation of coherence plays an epistemic role in the cognitive functioning.

2. Existence of two classes of illusions

In this section I shall introduce the distinction between two types of illusory phenomena by discussing a particular proprioceptive illusion provoked by the vibration of muscles of the limbs and I shall extract some considerations concerning the characterization of illusory phenomena when the notion of error is broadened as to include violations of coherence.
2.1 *Proprioceptive illusions of movement and position provoked by muscle vibration.*

Two kinds of illusions of movement and position can be produced by vibrating the muscles of the limbs: illusions of *impossible movement and position,* of which the subject can be directly aware with no sight, and illusions of *possible movement and position,* of which the blindfolded subject can only be aware when allowed to look at his vibrated limb or when informed by the experimenter\(^1\). The description of two experimental settings will hence suggest the existence of two classes or types of illusory phenomena: *illusions we are immediately aware of* and *illusions we are not immediately aware of.*

In the first experimental setting (Goodwin, McCloskey, and Matthews, 1972a), the blindfolded subject sits at a table with the upper arms resting on it and the forearms free to move. Vibration is applied to the tendon of the biceps muscle, thus producing the reflex flexion of the arm. While the muscles of an arm (experimental arm) are vibrated, subjects are asked to maintain the other arm (tracking arm) aligned with the experimental arm. In this way the tracking arm indicates the felt position of the experimental arm. As a result of the vibration, a reflex movement is produced in the experimental arm. The initial part of the reflex movement is not perceived by subjects (the tracking arm is kept still even if the experimental arm is moving). When subjects become aware of the movement of the experimental arm, they begin to move the tracking one. Meanwhile, an error of few degrees is produced, which is progressively increased by the fact that the tracking arm is moved more slowly than the other. Whenever the reflex movement of the experimental arm is arrested without the subject’s knowledge, subjects develop the sensation that the arm is being moved in the direction opposite to that of the reflex
movement. Subjects are not aware of errors as great as 40° until the blindfold is removed and they are allowed to compare the felt position of the arm with the viewed position. It is only in virtue of the comparison between two sources of information and in virtue of the recognition of a discrepancy between the two that awareness of the presence of some error arises. The awareness of the error is associated to a reaction of surprise.

The occurrence of an illusion of which the subject becomes aware in virtue of some successive exploratory action is not the only possible outcome of the vibration of muscles at the limbs.

A second experimental setting illustrates that when the movement of the experimental arm is contrasted by the imposition of a movement in the opposite direction, rather than simply arrested, subjects become aware of their error while experiencing the movement, and surprise immediately ensues. The immediate awareness of the error is associated with a judgment of impossibility concerning the felt movement and position. In the experiment described by (Craske 1977), for instance, the biceps and triceps tendons of the experimental arm are vibrated so as to produce a movement of flexion and the related muscles are stretched against contraction by moving the forearm in extension. The subjects are asked to judge when they attain the position of maximum extension at the elbow. Some subjects report a strange sensation, as if the arm was heavy or was bending or as if the arm was in two places at one time. Then, the subjects who have reported unambiguous sensations are newly vibrated and asked to move the limb beyond the point that they had previously reported as the limit of extension. As a result, all the subjects report the sensation that the arm is moving beyond the limits of extension at various degrees of hyperextension. This sensation is described as follows by the subjects: “the
arm is being broken”, “it is being bent backwards, it cannot be where it feels”. The subjects also display the signs that normally accompany pain, such as writhing, sweating and gasping, even if no pain is actually involved. The same results are obtained in the case of the vibration and movement of the hand into flexion, with the experimenter slowly moving the hand toward a position previously defined as the comfortable maximum: all subjects feel the hand to be bent backwards towards the dorsal surface of the forearm, that is, in an impossible position².

We can hence consider the sensations that arise from the second experimental setting as sensations of impossible movement and position that are immediately judged as wrong by subjects and we can distinguish the illusory phenomenon which is specific of the second experimental setting as an illusion one is immediately aware of. By contrast, the illusory phenomenon related to the first experimental setting can be defined an illusion one is not immediately aware of. In both cases the subject judges his experience as erroneous, in virtue of the visual appearance of his limbs once vision is allowed (for the not-immediately-aware condition), or in virtue of the specificity of the proprioceptive sensation which immediately appears as impossible, with no need for further exploration through the visual modality.

2.2 Proprioceptive illusions and coherence

Two hypotheses can be put forward for explaining the two cases of illusions of possible and impossible movement and position (Goodwin, McCloskey, and Matthews, 1972).
As a first hypothesis, the current perceptual experience of movement and position may be compared with stored knowledge about the motor possibilities of the limb or with expectations based upon this knowledge. The origin of both types of illusion would hence be attributed to the existence of a discrepancy between perceived information and the expectations that are based on previously acquired knowledge or experience (eventually re-actualized in the form of corollary discharges). In the case of the illusion of impossible rather than possible movement, the discrepancy would stand between current information and the knowledge that the joints of the arm or of the hand cannot go beyond a certain position without breaking or provoking pain. Nevertheless, the anatomy of the joints prevents the subjects from having experienced such positions in the past. Additionally, the illusion is inhibited when different forms of anaesthesia produce a lack of afferent sensations (Goodwin, McCloskey, and Matthews 1972), thus suggesting a role for the activity of the peripheral afferents and discarding the role of corollary discharges (which are present even in case of anaesthesia).

The second hypothesis hence makes reference to the fact that the position sense is affected by afferent sensations from the muscle and tendons and by afferent sensations from the joints and that in the case of the vibration a discrepancy stands between the two sources of information. The awareness of the impossibility of the movement experienced during muscle vibration would hence be the result of a conflict between two sources of proprioceptive information: the one registered by the captors of the joints and the other registered by the captors of the muscles and tendons.

Both hypotheses attribute the origin of the illusion to the presence of a discrepancy. Also, both in the case of illusions we are immediately aware of and in the case of
illusions we are not immediately aware of, when the presence of some error is detected, a reaction of *surprise* emerges; only, in the former case the error is immediately detected and thus surprise is immediately related to the experience, while in the latter case the subject needs to undergo other experiences (or to be informed by another subject) in order to discover the error and consequently to be surprised about his error. Surprise reactions are in fact tightly related to the awareness of committing an error (Davidson, 2004) in the sense that expectations based upon previously acquired beliefs (Dennett, 2001) or even upon sensori-motor connections, statistical learning and probability of co-activation (Castelfranchi, 2003) are unfulfilled by current experience. In virtue of his reaction of surprise, the subject himself is alerted to the presence of one of these conditions.

In other terms, illusions and surprise may stand in a direct or indirect relation. In the direct relation, the experience is such that the presence of an error or of an unfulfilled expectation is immediately detected, and the illusion is accompanied by surprise. In the indirect relation, surprise does not accompany the illusory experience, but arises as a consequence of the revelation of the experience as illusory, when the experience is compared with other experiences that do not match with it. In both cases nevertheless surprise arises from one and the same source: the presence of a *violation of coherence* (between the content of the information provided by different perceptual modalities, between current experience and past expectations, between current experience and communication from an informed source) which exists in reason of the presence of a *discrepancy* and which alerts the perceiver to the presence of an error. I introduce here a conceptual distinction between discrepancies and violations of coherence: discrepancies
exist between sources of information but they are not necessarily experienced by the perceptual system as inconsistencies (it is sufficient that the perceptual system attributes each of the discrepant items to a different object of the world); violations of coherence on the contrary are discrepancies that have had some effect on the perceptual system (such as the causation of an illusion) even if they can remain unaware; the same distinction will be practiced later in this paper between the presence of discrepant multi-sensory information and intersensory conflicts, where a distinction will be proposed between discrepancies, conflicts that are experienced as such and conflicts that do not become aware because they are solved in some way and hence remain to a sub-personal level.

These considerations suggest a different interpretation of the notion of illusion and of the notion of error than that of departure from facts. Errors in perception can be referred to the presence of discrepancies between some of the contents of the experience that give rise to experiences of violations of coherence at the personal (immediate awareness) or sub-personal ‘not immediate awareness) level.

Violations of coherence can be of two types, in correspondence with the two hypotheses emitted for the explanation of illusions provoked by vibration: diachronic and synchronic. In the case of diachronic violations of coherence the discrepancy stands between actual experiences and past experiences or beliefs or knowledge. In the case of synchronic violations of coherence the discrepancy exists between two or more stimuli that are simultaneously experienced.

This distinction is not to be taken as coinciding with the distinction between illusions we are immediately aware of and illusions we are not immediately aware of; in fact, as shown by the existence of different explanations for proprioceptive illusions of
impossible movement, illusions we are immediately aware of can both involve a
diachronic and a synchronous violation of coherence.

Illusions we are immediately aware of play a special role in the re-consideration
of the notion of illusion and in the adoption of a broader notion of error. In the case of
illusions we are immediately aware of, in fact, the discrepancy which gives rise to the
illusion also gives rise to the experience of a violation of coherence and to the awareness
of the illusion.

2.3 *Illusions we are immediately aware of*

The immediate or not immediate capacity of identifying one’s own experience as
wrong makes it difficult to renounce to the notion of error in the characterization of
illusions. Illusory phenomena analogous to the illusion of impossible movement and
position are especially significant in this sense, because the subject *immediately* emits a
judgment that refers to the experience he is undergoing as being impossible, hence
wrong. Surprise arises directly during the experience, hence signalling that the subject
who undergoes the illusion is aware that what he feels is not true or at least that what he
feels is inconsistent with some expectation.

Other examples of this immediate sensation of wrongness, are represented by the
perception of so called ‘visual paradoxes’ (such as Penrose two-pronged triangle or the
Necker cube). According to (Gregory, 1973, 1997) impossible figures make use of
pictorial rules in order to create the impression of the third dimension, but then some of
these rules are broken by other cues in the figure, so as to make the object impossible to
represent. The illusion of an impossible figure is thus explained as the application of
opposite rules for one and the same depiction. In the case of the perception of ambiguous figures, there seems to be no error, in the sense of a departure from the reality of the pattern of lines which is perceived. In fact, the subject correctly perceives all the features of the figure. But the fact that two possible interpretations are both present in the one and the same perceptual experience, and that they are not reciprocally compatible, provokes a reaction of surprise in the observer and the experience is described as bizarre.

The case study of proprioceptive illusions provoked by vibrations indicates that the notion of error should be broadened as to include violations of coherence and suggests that violations of coherence can be indicated as fundamental perceptual conditions for what concerns illusory phenomena; specifically, the violation of coherence can be considered as the causal source of the surprise reaction associated with illusions.

The fact that one becomes immediately aware of undergoing an illusion and that surprise arises directly is indicative of the fact that the illusion originates in a violation of coherence. In the case of illusions of impossible movement and position, for instance, it is the presence of a violation of coherence which causes the experience to be illusory (both in the hypothesis in which the discrepancy stands between current experience and expectations based on past beliefs and in the hypothesis in which the discrepancy stands between current experiences from different sensory channels); the error is in this way somehow perspicuous to the subject, in the sense that the presence of the discrepancy is sufficient for activating a reaction of surprise and alerting the subject to the presence of an error.

In the case of illusions of possible movement and position, the error is less perspicuous: even if the presence of a discrepancy is still at the origin of the illusion, the
production of another violation of coherence is required for the subject to become aware of the illusion and for surprise reactions to arise.

We can hence say that surprise associated to illusions always arises in virtue of the awareness of a violation of coherence, but also that only in certain cases the presence of a violation of coherence that causes an illusion is sufficient for alerting the subject to the presence of an error (sensation of impossible movement and position) while in other cases (sensation of possible movement and position) additional conditions must be added. Illusions we are not immediately aware of, in fact, can or cannot be caused by the presence of discrepancies, but even in the case in which the discrepancy gives rise to the experience of violation of coherence (at the sub-personal level) and hence to an illusion, the violation of coherence which is produced does not become immediately aware to the subject. Another violation of coherence must be produced for the illusion to become aware and for the subject to experience surprise.

2.4 Illusions we are not immediately aware of

The existence of illusions we are not immediately aware of is indicative of the fact that the experience of a violation of coherence (with subsequent reaction of surprise) is not the only possibility in presence of discrepancies within the stimulus situation or between stimuli and past expectations. In the case of proprioceptive illusions provoked by vibration, if the illusory movement is not perceived as impossible the illusion persists unnoticed. It is only in virtue of the acquisition of new information from experience (in the case of illusions of possible movement and position, visual experience compared with proprioceptive sensations) or from communication (information from the experimenter,
who knows the conditions of the experiment, compared with proprioceptive sensations) that the subject becomes aware of the presence of a discrepancy between the two contents: the content of the illusory experience and the content of the additional information with which it is compared. It is in virtue of the awareness of this further discrepancy (and not of the discrepancy which plays a causal role in the occurrence of the illusion) that the subject reacts with surprise and is alerted to the presence of an error as a violation of coherence. The two discrepant contents that permit the diagnosis of the presence of an illusion are hence not gained simultaneously and the experience which is afterwards recognized as illusory comes first. Surprise only arises upon the revelation that one has been taken in. Classic illusory phenomena described in the psychological literature mostly belong to the class of illusions we are not immediately aware of.

The difference between illusions we are immediately aware of and illusions we are not immediately aware of may be not appear clear-cut in a number of cases. Illusions we are not immediately aware of, in fact, have the possibility of becoming illusions we are immediately aware of. It is sufficient that the subject be primed, that is, that he be informed about the extension and direction of the movement of his limbs before the experiment takes place. In spite of the fact of being informed, the subject will nevertheless perceive an illusory movement and position, but he will immediately be aware of the discrepancy between the information gained through knowledge and the information gained through perception. This possibility arises in virtue of the so-called resilience of illusions to knowledge: knowledge is not capable of preventing the occurrence of a perceptual illusion and the same illusion will be experienced many and many times by the same person even after that the error has been discovered. Resilience
to knowledge assures *intra-subjective robustness* to illusory phenomena, which present always the same characteristics through time and changes. Illusions are also *robust inter-subjectively*, in the sense that any subject presented with the same pattern of stimulation will react with a similar illusion. Robustness (both inter- and intra-subjective), resilience to knowledge and the reaction of surprise associated with the awareness of the presence of an error are distinctive characteristics of illusory phenomena in general (both immediately and not immediately aware) and constitute the basis for a characterization of the notion of illusion which is not engaged with some specific theoretic approach to perception.

The case of illusions we are immediately aware of is nonetheless different from the case of illusions we are not immediately aware of because of the latter have the possibility of remaining unnoticed in absence of information gained from the experimenter or in absence of new explorations performed by the perceiver; illusions we are immediately aware of, on the contrary, can never remain unnoticed and the perceiver is always aware that something is going wrong with his perception.

In conclusion of this paragraph we can hence propose the following considerations: that two classes of illusions can be distinguished on the basis of the more or less immediate awareness of the presence of some error; that the error at the origin of an illusion can be coincident with a violation of coherence which stands between two or more contents of the experience, at the synchronic or diachronic level, and that the contents can have different sources (symbolic knowledge, sensori-motor expectations, perceptual information); that in the case of illusions we are immediately aware of the
violation of coherence which is produced by the discrepancy is sufficient for alerting the subject to the presence of some error and for raising a connected reaction of surprise. In view of the fact that the awareness of the illusion depends on the experience of a violation of coherence, it can be hypothesized that the cause of illusions we are immediately aware of always lays in some form of discrepancy. On the contrary, illusions we are not immediately aware of can or cannot be caused by a discrepancy, but they can nevertheless become aware only when mismatching information gives rise to the awareness of the presence of a violation of coherence. Since both illusions we are aware of and illusions we are not aware of can be caused by some form of discrepancy, the problem arises of the reason why the discrepancy gives rise to an experience of violation of coherence and to awareness of the error, only in certain cases. In other terms, the problem of the additional conditions that make the presence of a discrepancy give rise to the experience of a violation of coherence and a violation of coherence to become or not immediately aware.

3. Different solutions to the presence of discrepancies

Through the analysis of the role of coherence in perception and the exemplary case of multi-sensory conflicts, this section presents some reasons for the existence of different reactions on the side of the perceptual system in presence of discrepancies. It is broadly suggested that the discrepancy is experienced (violation of coherence) and noticed (awareness of the violation of coherence) only when the subject invest a certain cognitive interest in the experience and when the perceptual system cannot find a solution to the violation of coherence. And this, because of the fact that violations of coherence present a
negative effect on adaptive behaviours and their experience is hence avoided whenever it is possible.

3.1 Different solutions to the presence of discrepancies between past and present experiences

An experiment performed by (Bruner, and Postman, 1949) provides an example of violation of diachronic coherence and confirms that surprise, the emergence of a sense of wrongness and the awareness of an error is only one possible outcome in presence of a discrepancy between the content of past and present experiences. The experiment is directed to prove a sort of conservative nature of human cognition, according to which the perceptual field is actively organized as to maximize percepts that encounter the expectations (and needs) of the cognitive agent. When well-established expectations fail being confirmed, in fact, the agent may envision perceptual re-organization, and this poses a problem. For this reason, even if the agent is capable of perceiving incongruities, as long as possible, he will ward off the perception of the unexpected. In the experiment described by (Bruner, and Postman, 1949) some subjects are rapidly exposed to normal playing cards (five of hearts, ace of hearts, five of spades, seven of spades) and trick playing cards (i.e. black three of hearts or red two of spades, which are incongruous with ordinary cards), and are asked to name them. The results indicate that the recognition threshold for the incongruous playing cards is significantly higher than the one for normal cards and four reactions to incongruity are described. Dominance and compromise reactions are characterized by a perceptual denial of the incongruous elements in the stimulus pattern; in the first case either form or colour dominates and the
subject reports perceiving a normal card, i.e. a normal, red three of hearts instead of a black one, or a black three of spades. The perceptual result then meets the expectations about normal playing cards. In the second case a compromise object is perceived which constitutes the conflict, i.e., a greyish three of hearts. The perception of incongruity can also produce disruption, in that the subject cannot solve the recognition task. This failure in perceptual recognition provokes an inhibition of action, since it diminishes the efficiency of the organism (it seems to be infrequent). Finally the incongruity can be recognized. In this case, the recognition of the incongruity is accompanied by a sense of wrongness: the subject suddenly or gradually begins to feel that there is something wrong with the stimulus; this sensation can turn to disruption or give rise to recognition of the incongruity. The subjects of the experiment then manifest resilience to incongruity between the actual stimulus and their own expectations. When the incongruity is not suitably modified subjects have the sensation that something is wrong since they are faced with an ambiguity that they can accept (recognition) or not accept (disruption). In the case of disruption the violation of the coherence turns out to be paralyzing: ambiguity is a hard condition to be managed by action and perception.

Recent literature in social cognition and affective psychology (Geers, 2003) confirms the conservative nature of cognition and hence supports the idea that special conditions must be given for a discrepancy between current experience and expected result to be explicitly perceived and for a violation of coherence to be experienced. Studies on affective expectations in fact indicate that in presence of discrepancies between incoming stimulus and subject’s expectations, the stimulus is more likely to be assimilated to the expectations than to be identified as being discrepant. These studies provide an additional
explanation for the fact that a discrepancy between expectations and current experience can remain unnoticed (as it is the case for illusions we are not aware of) which is based on the will and possibility of thoroughly exploring the current situation. The discrepancy remains unnoticed when the level of attention and cognitive exploration that the subject invests in the incoming stimulus is low, and the incoming percept is suitably modified in accord with the expectations, hence an illusion can arise of which the subject is not aware. It is in fact shown by some experiments that, in case of discrepancies, people low in need for cognition tend to pass inconsistencies with their expectations unnoticed, and to assimilate the current experience to their expectations, while people high in need for cognition tend to notice the inconsistency and to show affective reactions that are in contrast with the expected affective states.

3.2 Different solutions to the presence of discrepancies between current experiences

The model of assimilation/contrast and the suggestion concerning the conservative nature of cognition are appropriated in case of diachronic violations of coherence between past expectations and current stimulus situation, but they do not apply to situations in which the discrepancy stands between two current sources of information, as it seems to be more likely in the case of proprioceptive illusions produced by vibration. Nevertheless, reactions analogous to the 4 outcomes to diachronic violations of coherence described by (Bruner & Postman, 1949) seem to be present even in the case in which discrepancies stand between current perceptual experiences in different sensory modalities. Also in the case of multi-sensory information, in fact, the presence of a
discrepancy can give rise to three conditions: aware states of conflict, unaware states of conflict and no conflict at all.

As a first possibility, the incoming discrepant stimuli are not combined by the perceptual system into one unitary percept, but the subject attributes each stimulus to a different object. In a classic investigation of a visual-proprioceptive discrepancy (Hay, Pick, and Ikeda, 1965) have shown that a stationary hand viewed through a 14° displacing prism feels as if it is located very near its seen location (bias of visual over proprioceptive information). If the displacement is bigger, the visual and the proprioceptive locations are not merged and the perceptual result of the discrepancy consists in two separated unisensory percepts. In this case there is hence no conflict because the partial percepts are distributed in different units. When the discrepancy is large, the perceptual system could simply treat the two stimuli as not relating to one and the same unit, but to two distinct objects.

It is only when the final percept contains two or more discrepant contents that the subject can be said to experience a perceptual conflict. Even in this case, nevertheless, two possibilities are left, as shown by the case of proprioceptive illusions produced by vibration: the conflict can become explicit and give rise to typical reactions, such as surprise, sense of impossibility and other, or remain un-perceived. We have advanced that illusions we are not aware of are the majority of the illusions that are described in literature. In the case of multi-sensory conflicts too, the aware experience of a conflict doesn’t seem to be a common situation, even if, as we have seen, it is an interesting one because the perceptual system can immediately detect the presence something wrong with the experience.
When two discrepant contents are suitably modified they enter the final unit without giving rise to an explicit conflict. The conflict is solved in favour of a non-ambiguous unit. Eventually, the perceptual system could maintain the conflict at a sub-personal level. The characteristics of the final percept depend on the kind of modification the contents of the incoming information have undergone. Here too we have two possibilities (which incidentally are analogous to the dominance and compromise reactions described by Bruner & Postman, 1949): as a first possibility, one of the stimuli might dominate over the others and thus by itself determine the features of the final percept; as a second possibility, all the incoming stimuli might contribute to the character of the final percept, by mutually influencing each other in various degrees. According to the dominance paradigm the final percept is dominated by one of the discrepant sensory modalities, typically by vision. This is what happens for example in well-known illusions such as the ventriloquist effect, where the voice of the puppet master is perceived as coming from the puppet’s mouth: vision seems to totally bias audition. The dominance paradigm has been introduced in relationship to an experiment concerning the discrepancy between vision and touch: subjects are asked to touch a square object and look at it through the interposition of minifying lenses (Rock & Victor, 1964); subjects are unaware of this modification, and they assume they are looking at and touching one and the same object, and the object is referred to have the dimension esteemed by the visual sensory modality. We know that the perceptual system realizes the difference between the two partial percepts, since the judgments given in the purely visual and in the purely tactile condition correctly correspond to the visual and to the tactile dimensions. But dominance does not seem to be the only possible solution to discrepancy between vision and touch. (Heller, et
al., 1999) have reconstructed the experimental setting presented in (Rock & Victor, 1964) and have shown that the solution the perceptual system finds depends on the task (consisting in more or less precise evaluations). When the judgment requested of the subjects is framed in terms of a precise measure (by indicating a visual measure on a ruler or by showing the measure by shaping a pinch with the fingers), there is dominance of a sensory modality over the other (in the case of the ruler vision dominates, but in the case of the pinch touch dominates over vision); on the other hand, when the subjects are asked to match the perceived extension with one object from a group of haptic or visual standards, the judgments seem to take into account both vision and touch in an equal manner and compromise solutions are put in place.

The fact that a similar pattern is described even in the case of synchronic violations of coherence, suggests the existence of general mechanisms that interest any kind of expectation and any kind of violation of coherence. Also, it supports the idea that both in the case of diachronic and of synchronic violations of coherence, the cognitive system has a strong concern in maintaining coherence, rather than in simply respecting previously acquired expectations. The conservative nature of cognition would hence be a consequence of the tendency, on the side of the cognitive system, to avoid violations of coherence at any level. If the re-organization that becomes necessary in case of diachronic violations of coherence is a problem for the cognitive agent, the effects of the awareness of a synchronic violation of coherence can be very negative for adaptive behaviour, and this would explain the existence of suitable mechanisms for avoiding an explicit state of conflict and would provide an explanation for this type of discrepancy to remain unnoticed. In the mean time, when a conflict cannot be avoided, the existence of
mechanisms, such as the reaction of surprise, that immediately alert the system to the presence of a violation of coherence would permit the system to promptly react with suitable, higher level strategies for facing the conflict.

3.3 General solutions to discrepancies

If we generalize these considerations to the case of illusions, we then assume that, in case of discrepancy between past and present experiences or between present experiences, the awareness of the illusion depends on the possibility of finding a solution to the discrepancy. When there is no possibility of modification or the modification is ineffective, the system is exposed to lack of coherence and can become aware of the presence of the violation of coherence and experience surprise, even if the discrepant information is not precisely individuated. Hence, in the case of illusions we are not immediately aware of, it has been possible for the cognitive system to avoid the awareness of the violation of coherence but the information is such that an illusion is experienced. When the subject engages in a second round of exploration, or when he is informed by the experimenter about the conditions of the experiment, the violation of coherence cannot be ignored anymore. This consideration is in accord with the hypothesis emitted in the frame-work of the study of expectations, that the discrepancy will remain unnoticed whenever the subject has not sufficient will or possibility of suitably exploring and acquire information concerning the incoming stimulus or whenever a compromise solution can be found. The availability of solutions to conflicts and violations of coherence in general can depend on several factors, between which, the
type of information involved, the magnitude of the discrepancy, the strength of the
expectations and the existence of motor strategies for avoiding conflicts

(Stein & Meredith, 1993) suggest in fact that the motor system plays a specific role in
the coherence of the perceptual outcome: one possible strategy that has the effect of
avoiding conflict in presence of discrepant stimuli is represented by functionally
decoupling the incoming stimuli through the active orientation of the sensory organs: in
situations of focused attention, for instance, the animal has a tendency to precisely
coordinate and align movements of the sensory organs, thus to maintain the sensory
organs and their corresponding maps aligned; the active alignment of the sensory organs
produced by suitable movements prevents the occurrence of discrepancies in normal
situations. Also, when the movement of one sensory organ in the direction of a target
stimulus has the effect of misaligning the different sensory maps, compensatory shifts in
the other sensory maps favor the alignment; in particular, it has been shown in the
observation of primates that when the rhesus monkey moves its eyes while keeping the
head and ears in their original position, a compensatory mechanism alters the effective
site of the auditory stimulus that activates a superior colliculus neuron. In other words,
the auditory receptive field of the monkey shifts with changes in the eye position.

Another reason must be individuated nevertheless, in order to explain why most
multi-sensory discrepancies remain unaware and most conflicts are solved. This reason
concerns the negative effects of violations of coherence for the cognitive system, and in
particular for the perceptual system.
3.4 The negative adaptive value of violations of coherence (both synchronic and diachronic)

The existence of experienced conflicts testifies that it is not always possible to solve a conflict and to ignore the presence of a discrepancy. (Stein & Meredith, 1993) describe a behavioural experiment where cats are exposed to discrepant stimuli. Cats are trained to orient and move toward a visual and/or an auditory stimulus to receive a reward. The presence of a discrepant auditory stimulus makes the probability of correctly responding to the visual one decreasing and gives rise to two possibilities: cats fail to respond in an overt fashion or they move to a position which is halfway between the visual and the auditory stimuli. The two reactions correspond to the experience of an explicit conflict and to a compromise solution. The results of the experiment also indicate that the experience of an explicit conflict in presence of spatially disparate stimuli presents a negative value for adaptive behaviour, at least for the orientation and the direction of attention. In fact, the explicit experience of a conflict provokes an inhibition of action and cats fail to respond. Cats are not necessarily aware of the presence of a conflict or of an error, they just present a behavioural reaction to a certain stimulus conditions. Human beings, on the contrary, have the further possibility of becoming aware of the presence of some conflict or error (without precisely identifying the terms of the conflict or the erroneous information) or even of identifying the terms of the conflict or the erroneous information.

But even if coherence has a positive value and violations of coherence entail negative effects for adaptive behaviours, the fact of being alerted to their presence puts the subject into the condition for adequately facing the discrepancy. If we assume that violations of
coherence in perception have a sort of “freezing” effect upon action and action programming, then we can suggest that, at least in some cases, the inhibition of action might hold effects that have a positive adaptive value. In some situations, for instance, the inhibition of action produced by the awareness of the conflict allows the subject to re-consider the stimulus, to perform an additional exploration in order to solve the ambiguity in a sense. Or it may be possible that the inhibition of action gives the subject the chance to consider the situation in a more complex cognitive light, without directly giving rise to action as a response to perception, but helping himself to considerations that include different types of reasons. If we can imagine situations in which action is not immediately requested (as in the case of chase or escape behaviors, which are the basic adaptive behavior taken into account by Stein & Meredith, 1993, for instance) and the recourse to thought and the use of higher level concepts is prized, then we could accept that the freezing of action produced by the awareness that coherence is violated has an adaptive value.

This value, nonetheless, depends on the ability on the side of the agent to immediately detect violations of coherence and to act in order to reduce inconsistency. In fact, even if the freezing of action can be considered to have a positive value when it leads to subsequent exploration and to a more reflective response to the stimulus situation, a response must be given. It will then be demanded of the successive exploration and of the conceptual reflection to provide a decision for action which is univocal. A solution that was impossible at an automatic level (through the intervention of the neurophysiological processes described above as solutions to conflicts) has to be found at the conceptual level. Hence, in some way coherence is restored.
It seems thus that violation of coherence doesn’t have a positive adaptive value in itself. In fact, the freezing of action which is provoked by violations of coherence has positive consequences only when the subject has the possibility of putting into action other explorations or higher order reasoning. On the contrary, the destructive consequences of discrepant stimuli over maps alignment and the existence of mechanism for the organization and the maintenance of the alignment of the maps seems to prove that coherence (in the sense of the coherence of the incoming stimuli) is an important quality of the perceptual outcome and a value for the perceptual system.

Another problem concerning the adaptive value of coherence consists in the possible conflict with the adaptive value of truth. Even if coherence seems to present an adaptive value for perception that violations of coherence might not have, nonetheless the reestablishment of coherence is not necessarily coincident with the reestablishment of the truth. On the contrary, the reduction of inconsistency could work against truth, as it happens in the case of solved perceptual conflicts, where the perceptual result is coherent but it doesn’t adhere to either of the incoming stimuli. As a matter of fact, one can be wrong in modifying the actual perception of some state of affairs or in holding it as false just because it contradicts some previously acquired knowledge or some previous experience. The theory of cognitive dissonance (Festinger, 1957), for instance, confirms that the human mind tends to reduce inconsistency between cognitive states and indicates different strategies for carrying out this reduction. Nevertheless, the theory of cognitive dissonance points out, there could be negative effects in pricing coherence between cognitive states (such as beliefs) more than the truth of the belief which is held. Since cognitive dissonance is assimilated to a state of distress, such as thirst, the subject seems
to be strongly driven to the modification of his beliefs in order to reduce the state of stress. The reduction of the inconsistency thus presents a positive value for the well being of the subject. But, in order to gain a more comfortable condition, the subject might be inclined to give away true beliefs just for reestablishing harmony between his cognitive states. This choice could entail negative consequences upon adaptive behavior. What is adaptively negative here, anyway, is not the recognition of a conflict between past and present experiences or between present experiences, but the type of solution which is adopted in order to reestablish coherence. The decision about which experiences or cognitive states are to be modified and how, constitutes a further step. As we have seen in the case of intersensory conflicts, different hypotheses can be expressed about the conditions the perceptual system takes into account when choosing between combining or non-combining two discrepant stimuli, and about their respective role in the final combined percept. Anyway, being unable to recognize the state of conflict cannot be more valid from an adaptive point of view than identifying it and trying to solve it along one direction. Additionally, even if truth and coherence can be in conflict when single beliefs or percepts are at stake, this is not necessarily true for large sets of beliefs or other intentional states. (Davidson, 1984, 1986) for instance denies the possibility for a large set of coherent beliefs to be false, and in general for a large set of beliefs to be false and reconciles coherence and truth.

4. Conclusions. Epistemological value of the awareness of being victim of an illusion

(Davidson, 1984) requests that mostly true beliefs are assigned to one, even though any of one’s beliefs can be false. Anyway, one considers one’s own beliefs as true
until one discovers that a certain belief is false, whence the reaction of surprise. If there are no particular reasons to doubt, hence, perceptual experience is normally assumed to be believable. It is only in special conditions that one puts one’s perception into doubt and asks oneself if one should believe or not in what one perceives or believe in what one believes.

An experience which is inconsistent (synchronously or diachronically) with other experiences and knowledge alerts the perceiver to the possibility of error, by causing surprise and a sense of wrongness, bizarreness, impossibility. In these conditions, actual perception is not suitable to immediately give rise to a corresponding belief which is held as true. When the content of the experience that $p$ is recognized as inconsistent with the contents of other experiences or past knowledge and when the experience that $p$ provokes a reaction of surprise or a sense of wrongness, bizarreness, impossibility, the judgment that $p$ is taken as possibly false. The world is unlikely to be as the experience that $p$ presents it to be. The immediate recognition of the possibility of an error in the perceptual experience carries an *epistemological value* for the subject.

The subject who is victim of an illusion can hence immediately or later become aware that something is wrong with his experience, in a broad sense: he is not necessarily able to indicate which of his experiences is the wrong one, but the fact of becoming aware of the presence of a discrepancy between two or more experiences, of the presence of a violation of coherence, alerts the perceiver to the possibility of error.

In virtue of the normal coherence of the perceptual experience, the discrepancy between the information provided, for instance, by different sensory organs provokes both a synchronic and a diachronic violation of coherence. As a matter of fact,
discrepancy stands not only between actual sensations of different sensory organs, but also between current perception and the past stream of experiences which is continuous and coherent (Husserl 1990 Original work published 1952; Dokic 2004). Thus, a veridical experience and an illusory one can be distinguished without making reference to extra-mental states both in virtue of a synchronic and of a diachronic violation of coherence. Nevertheless, even if all the senses but one are concordant, the only sense which is in contradiction with the others cannot be simply discarded and the coherence of the experience reestablished by trusting the senses that are in accord: coherence per se is not necessarily a sufficient indication of truth (Husserl 1990 Original work published 1952). Only ruptures in the coherence of the normally concordant experience force the subject to consider the difference between appearances, that can be true or false, and reality.

This fact has a great importance for characterizing the role that illusions might play in the cognitive functioning. In fact, the awareness that something is wrong represents an epistemological judgment about one’s own experience. The judgment that something is wrong, that is, that there is an error, is internal to the course of experiences of the subject because it depends on the individuation of a discrepancy between two or more experiences of the subject and not on the comparison of the experience of the subject to and extra-mental reality. Hence, illusions, and in particular illusions we are immediately aware of, present the epistemological role of directly alerting the subject of the presence of an error in the course of his experiences with no necessity of ‘stepping out’ from the course of experiences itself. The inconsistent experience of an illusion we are immediately aware of has a lot of chances of being wrong because it violates the general
expectation, based on long run experiences, that experience is coherent. For the same reason, experiences that do not immediately look wrong can be recognized as illusions when they are contrasted against knowledge (gained by an external source) or against further exploration, because a violation of coherence is produced: one of the contrasting contents must be wrong; it is not a necessity that the first experience is wrong and the further explorations or knowledge are true, and the fact of trusting the experimenter or more attentive explorations is just a matter of choice. On the basis of the evidence from illusion, it can hence be suggested that the cognitive system makes use of coherence hints (of hints about the violation of coherence) in order to decide the truth value of his experiences; in particular the subject would make use of violations of coherence as indications of the possible falsity of his experiences. The special value of violations of coherence and of illusions we are immediately aware of, is represented by the reaction of surprise when faced to experiences that look or feel wrong, impossible, thus creating the possibility of immediately issuing a judgment about the truth value of the experience.

Illusions (and in particular illusions we are immediately aware of) and their behavioural and phenomenological consequences (surprise, sense of wrongness) thus represent an epistemological value for the subject because violations of perceptual coherence might be significant signals for the possibility of actually being mistaken. Thus, violations of perceptual coherence can be used by the subject as criteria for establishing the credibility of the perceptual experience.

References


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1 (Eklund 1969 1971 1972); (Craske, and Cranshaw 1974); (Craske 1977); (Craske, Kenny, and Keith 1984); (Goodwin, McCloskey, and Matthews 1972a 1972b 1972c 1972d).