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Mirrors and misleading appearances

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Abstract

Although philosophers have often insisted that specular perception is illusory or erroneous in nature, few have stressed the reliability and indispensability of mirrors as optical instruments. The main goal of this paper is to explain how mirrors can contribute to knowledge and at the same time be a source of systematic errors and misleading appearances. To resolve this apparent paradox, I argue that mirrors do not generate perceptual illusions or misperceptions by defending a view of mirrors as transparent and invisible visual media. I then consider the reasons for which mirrors are said to be misleading. Contrary to the illusory account, I defend a nonperceptual approach to the errors attributable to mirrors which analyses the kind of errors generated by the use of mirrors in terms of false judgments. I further show that a nonperceptual view of errors extends to all the cases in which a sensorimotor adaptation is required, such as perception through magnifying or inversing lenses.

Keywords : illusion, perceptual error, naive realism, perceptual media, mirror

1. The mirror paradox

Whereas complex optical instruments like telescopes and microscopes are usually trusted by laypeople and scientists to enrich their perception of reality, simpler optical

devices like mirrors elicit questions and suspicions. Although mirrors are indispensable tools designed to assist us in a variety of daily tasks, they are also considered misleading devices that can generate illusions and errors. The fact, for example, that magicians use mirrors to mislead their audiences and that the appearance of our left and right hands is reversed in a mirror suggest that what we see in mirrors is erroneous or illusory. This is the apparent paradox nicely captured by Pendergrast in his historical monograph on mirrors [2003: ix]: "The mirror appears throughout the human drama as a means of self-knowledge or self-delusion. We have used the reflective surface both to reveal and to hide reality".

Although philosophers and psychologists have turned to the example of mirrors to explain the links between optics and vision and, more generally, to illustrate their views of the nature of perception, specular perception per se has received very little attention.[1] This paper intends to partly fill this gap by investigating the nature of specular perception and by explaining how it differs from nonspecular perception. Although philosophers have often insisted that specular perception is illusory or erroneous in nature, few have stressed the reliability of mirrors as optical instruments. Depending on their shape, mirrors not only provide an indispensable aid in the bathroom, but are also used in all kinds of scientific instruments, such as telescopes, microscopes, and cameras, and therefore directly contribute to scientific progress. Explaining how mirrors can contribute to knowledge and at the same time be a source of systematic errors and misleading appearances is the main challenge faced by a theory of specular perception. Because mirrors generate false beliefs, specular experiences has been identified with illusions. This common view is expressed by Vendler as follow [1994: 322]:

> Mirror images provide a good analogy... We see them, yet they are nothing in the physical world. The mirror image of my face appears behind the mirror, yet there is nothing there but bricks.

[1] Notable exceptions in the recent literature are [Casati 2012; MacCumhaill 2011; Steenhagen 2017].

The illusory approach to specular perception, which claims that there is nothing in the world corresponding to the mirror image perceived, has some significant consequences. It involves in particular that naive realism cannot account for the banal experience of seeing our own face in a mirror since, contrary to the central core of this view, there is no mind-independent objects and properties corresponding to the way our face appears in the mirror. To resist this consequence, this paper will reject the illusory view of specular perception and favour an approach to specular perception compatible with naive realism.

But before taking up this challenge and addressing the apparent mirror paradox, let us consider the puzzles that occupy the scientific and philosophical literature on mirrors.

2. The mystery of mirrors

Since Plato, philosophers have discussed the fact that mirrors reverse right and left. For example, when we look at ourselves in the mirror, it seems that our face and our body are right–left reversed: the watch on my left wrist appears to be on my right wrist, whereas the scar on my right eyebrow appears to be on my left eyebrow. But the right–left reversal is not restricted to self-perception. Take, for example, the way writing looks in mirrors: whereas **PLATO** reads from left to right, its appearance in the mirror, **OTALԀ**, reads from right to left.

Mirrors' right–left reversal is frequently contrasted with the lack of a corresponding up–down reversal. This asymmetry is often invoked to stress the mystery and magic associated with mirrors. Consider how Richard Gregory introduces this problem in *Mirrors in Mind* [1997: 84]:

> This most famous mirror puzzle has confused bright people for centuries. So, why is everything in a looking-glass right-left reversed yet not reversed up-down? For example, why does *writing* appear as horizontally reversed though not upside down—as "mirror writing"? The reader may find this simply obvious.

> Most people, however, go through their lives without even considering it. Once considered, it can remain a puzzle for life.
> How can a mere *mirror* distinguish right-left from up-down, even though many *people* don't know their right from left?

According to Gregory, the puzzle is not so that mirrors reverse right and left. The real enigma seems rather to be that mirrors reverse things along the right–left axis but not around other axes, such as the top–bottom axis.

But the seemingly magical properties of mirrors go beyond their ability to reverse right and left. Consider the face you see in the mirror when you brush your teeth. The eyes you see in the mirror are looking in the direction opposite to the one in which your eyes are actually looking. If your face is directed to the north, your face in the mirror is directed to the south. Objects seen in mirrors are therefore also frontward–backward reversed.

Even more puzzling is the problem of spatial location. Although you know that the mirror hangs on the bathroom wall, it may seem to you that the face you examine in the morning while brushing your teeth is in front of you, as though "behind" the bathroom wall. But of course there is nobody behind the wall, even though it may seem that a doppelgänger is staring at you. So, where is your reflection? On the mirror's surface, somewhere in your imagination, or nowhere at all?

The illusory nature of specular perception is borne out also by the fact that observers seem to be systematically misled about what is visible in a mirror. People tend, for instance, to considerably overestimate the size of their mirror-reflected face [Bertramini & Parks 2005] and ignore where they should stand to be able to see themselves in the mirror [Bertamini, Spooner, & Hecht 2003]. Because mirrors are ubiquitous and most people interact with them on a daily basis, it is surprising that beliefs about them can be systematically mistaken.

Mirrors are certainly peculiar objects that give rise to distinctive visual experiences. However, I will argue that, contrary to a widespread view, mirrors do not generate perceptual illusions or misperceptions.

My argument has two parts. First, I argue that mirrors do not generate perceptual illusions or misperceptions by defending a view of mirrors as *transparent and invisible* visual media. The perceptual medium view of mirrors is contrasted with the pictorialist view, according to which specular perception involves an image-like entity such as a reflection or a mirror image. According to the perceptual medium view, we don't see anything in a mirror except the objects reflected. In the second part of the paper, I consider the reasons for which mirrors are said to be misleading. Contrary to the pictorialist approach, I defend a nonperceptual approach to the errors attributable to mirrors. According to this view, the kind of errors generated by the use of mirrors is better analysed in terms of false judgments than in terms of perceptual errors or perceptual illusions. In addition, I argue that the nonperceptual view of errors extends to all the cases in which sensorimotor adaptation is required, such as perception through magnifying or inversing lenses.

3. Mirrors without mirror images

The word *image* is often used to describe what is seen in a mirror, and many authors have stressed the similarities between mirrors and pictures or images to explain specular perception. Consider Leonardo's understanding of how mirrors should guide the painter:

> When you wish to know if your picture be like the object you mean to represent, have a flat looking-glass, and place it so as to reflect the object you have imitated, and compare carefully the original with the copy. You see upon a flat mirror the representation of things which appear real; Painting is the same. They are both an even superficies, and both give the idea of something beyond their superficies. [Leonardo da Vinci 1877 : CCCL].

According to Leonardo's guidelines, pictures and mirrors are similar because they are

both surfaces capable of representing something "beyond their superficies." Their similarity rests on a shared representational mechanism that enables them to represent things "as if they were real." Like Leonardo, many authors seem to think that mirrors work like pictures insofar as they create the illusion that there is a three-dimensional reality beyond their surface.

The nature of pictures, itself a difficult philosophical problem, has been a matter of some debate over the last two decades. My goal is not to take sides in this debate by providing a philosophical account of pictorial perception and pictures, but rather to compare them with specular perception and mirrors. Although there are contrasting approaches to what counts as a picture, it is safe to say that realistic pictures are flat, marked surfaces that represent a three-dimensional arrangement of coloured shapes. The nature of pictorial perception is still intensely debated in the literature, but we can say without much controversy that pictorial perception, unlike "face-to-face" experience, is mediated by pictures. Following Wollheim, we can characterize the experience of looking at pictures as an experience of *seeing-in*. Unlike face-to-face seeing, Wollheim argues, seeing-in is "twofold," because it involves the awareness of a painted surface *and* the awareness of a represented scene. He writes [2003: 133]

> When a picture represents, say, a horse, the appropriate experience to be had in front of it is to see a horse in its painted surface, and what is most distinctive of the phenomenology of such an experience is what I call twofoldness, or that, within a single experience, but as separate aspects of it, I am aware of the surface and of a horse.

The question I would like to consider is whether specular perception is twofold, like pictorial perception[2], or at least dual in some way,[3] and whether the role played by

[2] Although it is not the only option, the twofold view is the most discussed approach of pictorial perception. One important exception is Briscoe [2016: 55] who reject the twofold view and argues that "pictorial experience and seeing face-to-face are experiences of the same psychological, explanatory kind".

[3] I prefer the term *dual* to *twofold*, because Wollheim explicitly holds that the two aspects of seeing-in occur simultaneously in a single experience. This view is contested by many philosophers who do not

reflection in specular perception is in some way similar to the role played by pictures in pictorial perception.

The commonly used term *mirror image* suggests that specular perception, like pictorial perception, is dual. There is, on one side, the experience of a mirror image or of a reflection lying on the surface of the mirror, and on the other side, the experience of an arrangement of three-dimensional objects occupying a region located behind the surface of the mirror. According to this view, specular and pictorial experiences are quite similar, because both are dual: they both involve the awareness of a surface and a three-dimensional scene. I will call "pictorialist" the view that specular perception involves some kind of seeing-in. Like pictorial perception, a pictorialist view of mirrors maintains that specular perception involves a kind of perceptual acquaintance with a surface. According to Casati's [2012] terminology, the pictorialist view of mirrors is a multiplier account. Multiplier accounts of mirrors, which rely on entities like reflections or mirror images in their analysis of specular perception, are contrasted with unifier or deflationary accounts. Unifier accounts do not postulate supplementary entities in addition to the objects reflected in mirrors. According to the unifier account, when I see myself in a mirror, the only object I perceive is me; that is, contrary to the multiplier account, I do not see an image or a reflection.

Most accounts of mirrors embrace a multiplier approach by referring to entities, like images, in their analysis of specular perception. I will argue that a major consequence of this view is that it generates confusion and pseudoproblems, such as the puzzle of right–left reversal or the mysterious existence of a virtual world located behind the looking

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share Wollheim's account of pictorial perception: either because they maintain that seeing the painted surface and the depicted object occur alternately and not in a single experience [Gombrich 1960] or because they maintain that seeing-in is not purely perceptual [Walton 1984]. My use of the term *dual* is more neutral, and it is meant to give a minimal description of what is involved in pictorial perception without committing me to a position in the controversy surrounding the nature of pictorial perception.

glass. To avoid these traps, I suggest taking a fresh look at mirrors—that is, one that drops the pictorialist framework.

4. Indirect seeing: seeing-through vs. seeing-in

If mirrors are believed to involve some kind of image, I suppose it is because both pictorial and specular perception are indirect. When we choose a new pair of boots by carefully examining the pictures in a fashion magazine, we don't see the boots *directly*, as we would if we were looking at them in a store. Similarly, when we watch a car in the rear-view mirror, it seems that the car is not directly perceived, as it would be if we had turned our head in its direction. Compared to face-to-face perception, both pictorial and specular perception appear to be *indirect*. But as J. L. Austin [1964: 18] warned, the notion of indirect perception is thoroughly ambiguous, because it "can cover too many rather different cases to *be just* what is wanted in any particular case". To avoid the ambiguities surrounding the philosophical use of the term *indirect perception*, it is therefore necessary to understand the ways in which perception can be said to be indirect. The case of specular perception offers the perfect occasion to do so.

Although mirrors can be considered perceptual intermediaries, I will show that the kind of mediation they perform is very different from the way images work.

Perception can be said to be indirect because it is mediated by the perception of something else. The perception of the Eiffel Tower on a postcard, for example, is indirect, because the perception is mediated by the perception of a printed surface.[4] To say that a perception is indirect in this sense is therefore to say that seeing x implies seeing y. But a visual perception can also be said to be indirect because it relies on the causal properties of a medium or of a combination of media. According to this second

[4] According to Walton [1984], photographs are mechanical aids to vision like eyeglasses, telescopes, and mirrors. Walton argues that photographs are transparent and that we see the past *through* them. According to Walton, photographs must be contrasted with paintings, which are not transparent in this way.

interpretation, we can say that a perception of x is indirect because seeing x involves seeing x through y.[5] This is the case, for example, when we perceive snow through tinted glasses or when we observe an insect with a magnifying glass.

Therefore, seeing x indirectly can mean either

(1) seeing x by seeing y

or

(2) seeing x through y.

My claim here is that mirrors are perceptual intermediaries in sense (2) and that the ambiguities characteristic of talk about mirrors rest on a confusion about these two senses of "seeing indirectly." To account for their role as intermediaries, I have proposed in Mizrahi [2018] to consider mirrors as perceptual media in the sense developed by Heider. The main virtue of this approach is that it accounts for both the differences and similarities between perception through mirrors and perception without mirrors.

5. Perceptual media as causal intermediaries

While trying to explain how perception at distance was possible, Fritz Heider [1959] made a major contribution to the understanding of perceptual media. He suggested that a special kind of mediator between the perceiver and the object perceived was needed in order to carry the perceptual information from the perceived object to the perceiver. This perceptual mediator, he argued, should be able to causally interact with the perceived object and the observer, but also to guarantee this causal mediation without interference.

[5] We can note here that the English distinction between "seeing y *in* a mirror" and "seeing x *through* a mirror" seems to capture the same distinction.

Heider specified the physical characteristics for entities to be perceptual media, but he also stressed their phenomenological "absence". He observed in particular that to convey information without interference to the perceiver, the perceptual medium must be transparent. Otherwise, he argued, the information transmitted by the perceptual medium would not be about the perceived object but also about the medium itself.

I believe that Heider's approach to perceptual media is fundamentally correct : perceptual media are not perceived although they play a fundamental role in guaranteed perception.[6] As explained by Heider, this role is to provide a causal intermediary between the perceived object and the perceiver and therefore to explain how perception at a distance is possible. There is however another major function performed by perceptual media in perception which must be recognized and understood in order to fully apprehend the centrality of perceptual media in perception.

Although it is correct to say with Heider that the perceptual medium causally transmits information about the environment, it is equally important to stress that this information constitutes only a tiny portion of the information available. To fully grasp the role of media in perception, it is indeed imperative to realize that our environment is causally dense and very complex and that only a limited fraction of the world that surrounds us is accessible by our senses. We see coloured surfaces, hear sounds, and smell odours, but a large number of causal processes that take place right before us are not directly perceived. For example, we don't perceive radioactivity, geological changes, or most

[6] However, most ordinary transparent objects are not perfectly transparent. First, materials often contain impurities that make them partially opaque. (See Mizrahi [2018: 243-6) for an account of translucency and blurriness). Second, due to their shape and their surfaces, most transparent objects locally reflect some light; this is the case, for example, with the edges of a pane of glass. This fact does not however constitute a problem for the claim that transparent media, like glass, are invisible, because reflections occur when the light is not completely transmitted by the medium and therefore when the medium is not completely transparent. Transparency and reflection are in effect opposite phenomena which is confirmed by the fact that the region of the glass we can perceive by perceiving the specular properties of the glass (typically the edges) are not perceived as being transparent. An object can then be partially visible and invisible depending on what region of the object is perceived. In that case, the object, or a part of it, ceases to be a visual medium and becomes the direct object of perception.

electromagnetic processes. Heider's notion of perceptual media is an invaluable resource for explaining how perception extracts information from this complex web of causal relations.

The kind of information conveyed by a medium is directly correlated with the kind of causal process involved in this medium. Consider water. Like air, water is a medium for sound and light, but it is also a good conductor of electricity. It is therefore unsurprising that electroreception is found in most aquatic animals. In fact, it appears that the capacity to detect electrical signals in the environment arose early in evolutionary history but was subsequently lost in those vertebrates that crawled onto land, because air, a poor medium for electricity, replaced water as their natural habitat. Perceptual media enable the transmission of information, but they also select what kind of information is available to the perceiver. This is why perceptual media, although not perceived, fundamentally shape the way we perceive the world.

The central claim of this paper is that mirrors, like air, water, and glass, are visual media.[7] This claim certainly faces some difficulties. After all, is it not obvious that we perceive mirrors as we perceive the ordinary objects of our environment? Is our physical interaction with mirrors not a confirmation that we can see mirrors just as we can see chairs or tables? If, at first sight, mirrors do not seem to differ in any significant way from other pieces of furniture, their visual properties are noticeably extraordinary. From a physical point of view, mirrors are opaque objects: they reflect incoming light and don't transmit light the way transparent materials do. But from a phenomenological point of view, the issue is more complex. Mirrors are phenomenologically opaque in relation to objects located behind them. If a mirror hangs on a wall, for example, the observer cannot see the portion of the wall covered by the mirror. But unlike opaque objects, mirrors are colourless. The colours we see in mirrors are the colours of the

[7] See Mizrahi [2018].

objects we see in them: the mirror "looks" blue if it reflects the sky or white if it reflects snow.[8] Therefore, unlike opaque objects, mirrors are perceived as transparent in relation to the objects they reflect. Like a pane of glass, a mirror is not a visual barrier to what is perceived through it.

Like perceptual media in general, mirrors are not perceived but nonetheless crucially contribute to our perceptual experiences by selecting which portions of reality are perceptually accessible. Consider the periscope, which is a tube containing two parallel mirrors that enable the viewing of objects from a vantage point normally unavailable to the observer. Although perception through a periscope is mediated by mirrors, no mirror is present at the phenomenological level. The phenomenology of looking through a periscope involves only the actual objects and qualities that are seen through the periscope; it does not involve the mirrors that are causally involved in that experience. If the experience of looking through a periscope differs from the experience of looking through glass, it is because mirrors and glass don't give the same access to reality. But what are the distinctive features of specular perception, and what exactly do mirrors contribute to the way we perceive the world? These are the questions I address in the next section.

6. Mirrors as visual media

Like the use of any optical instrument, the use of mirrors enlarges our visual capacities: they extend our visual field to portions of space not immediately accessible to us by providing a different visual perspective without forcing the observer to change his current position. The use of a rear-view mirror in a car, for example, enables drivers to see regions of space behind their car without turning their head, whereas the use of a periscope enable observations over, around, or through obstacles that prevent direct

[8] The case of tinted mirrors parallels exactly the case of tinted glass explained in Mizrahi [2010; 2018: 247-250].

line-of-sight observations.

To understand why the visual experiences provided by mirrors are veridical and not illusory or erroneous, it is crucial to note that seeing always involves at least one visual medium. Because air is the usual visual medium, we tend to forget its central role in perception. Thus, when light rays are transmitted through a different medium, we are generally aware of the change in perception this generates. As stressed by Arthadeva, we become aware of perceptual media only when two media contribute simultaneously to a perceptual experience. Otherwise, as he remarks, we tend to ignore their role in perception [1959: 135]:

> We must not forget that when we see the stick in water we see through the water: because part of the stick is actually in the water we have to see through the water if our vision is to reach it. Similarly, though we do not bother to remind ourselves of it, we see the part of the stick above the water through the air. In fact, the further away we are from the stick, the more air we see through when we see it. Because air is usually completely transparent we tend to neglect its presence, but we must not forget that it exists and is as material as other things. Seeing through air, seeing through water, likewise seeing through other media or through lenses, are different kinds of seeing.

In fact, there is no adequate or inadequate perceptual medium per se, but only media tailored to particular perceptions. Consider the case of corrective eyeglasses. People with myopia, for example, cannot focus on distant objects. This very common problem is easily corrected with diverging lenses. People with hypermetropia, on the contrary, have difficulties viewing nearby objects, and they need converging lenses to improve their vision. Although converging and diverging lenses have opposite optical properties, it is remarkable that their use as vision aids achieves exactly the same goal: they give "normal" vision to people suffering from visual "abnormalities."

The fact that normal vision can be achieved through the use of different optical instruments shows clearly that lenses are not perceived. When myopic subjects wear eyeglasses, they do not see the optical properties of their eyeglasses in addition to the objective properties of their environment. What they do see are the visual properties that

were not visible to them without wearing eyeglasses. Refractive lenses don't have any intrinsic phenomenological properties; they only change perceptual experiences by changing what portion of reality is accessible to the perceiver.

The various puzzles associated with mirrors that have troubled philosophers and scientists can be solved by the proposed approach to perceptual media. Unlike the pictorialist view of mirrors, the perceptual-medium theory assumes that specular perception is not fundamentally different from face-to-face perception. In both cases, the phenomenology of the perceptual experience is constituted exclusively by the objects and their properties. Contrary to the pictorialist view, the perceptual-medium view does not involve relations to intermediary objects like mirror images or reflections and assumes that the difference between specular perception and face-to-face perception can be exhaustively explained by the nature of what is perceived in both cases.

Using Casati's very apt example, suppose Captain Hook, who has a hook in place of his right hand, stands before a mirror. What does he see? According to the pictorialist view of mirrors, he sees a reflection or a mirror image of himself that is apparently right–left reversed, because it will seem to Captain Hook that he is missing his left instead of his right hand. But according to the perceptual-medium view of mirrors defended here, there is no right–left reversal, and therefore no perceptual illusion or error. What Captain Cook perceives is his own left hand and the hook replacing his right hand—precisely the objects he can perceive directly by turning his head or lifting his arms. According to this last suggestion, the difference between perceiving something through air and doing so through a mirror is merely perspectival. Although there is a strict correlation between the direction of the gaze and the location of the objects perceived in both cases, this correlation is not the same. Because light travels through air in straight lines, the line of sight when seeing through air is straight: the objects perceived and the eyes of the observer are situated along a straight line. By contrast, when an observer is

looking into a mirror, the line joining his eyes and the perceived object is not straight. As you face a mirror, you can perceive objects located behind you or next to you. Although specular perception is not directed along a straight line joining the perceiver's eyes and the perceived object, there is a distinctive correlation relating the direction of sight and the location of objects perceived through a mirror. When an observer turns his or her head to the right and looks into the mirror, the objects he or she perceived are located to his or her right; when he or she looks to the left, he or she sees objects located to his left. Contrary to the prevailing myth, the distinction between left and right does not seem to be affected by the use of a mirror, because the direction of the gaze is systematically correlated to the spatial location of the object.

The difference between perception through air and perception through mirrors is based on the way vision is coordinated with the motor system and the other sense modalities. Because perception and motor action are closely related, any change in this perceptual–motor coordination requires some adaptation. Adjusting our behaviour to new visual information is required in all situations where a new perceptual medium is introduced. It includes situations where people use mirrors, but also those where they use magnifying or shrinking lenses and displacing or rotating prisms. All these situations differ from those associated with "normal" perception according to the way the plurality of frameworks associated with the different sense modalities and motor systems are coordinated.

The belief that specular perception involves seeing reversed replica located behind the mirror is indeed less plausible when one considers situations where the perceptual-motor coordination has been restored. When looking in the rear-view mirror of your car while driving on the highway, you see the traffic approaching from behind, you don’t see little cars coming in front of you. Situations, like driving, exclude (thankfully) situations where the perceiver mislocates objects as being positioned behind the surface

of the mirror facing the observer. Although mirrors can sometimes give rise to errors, those misleading situations are incompatible with situations involving a correct use of mirrors. Both situations rely indeed on mutually exclusive visuo-motor maps. As stressed by Casati [2012: 201], it is only by feigning epistemic innocence that "one maintain one had the impression that the hook had moved from the right arm to the left, and that therefore mirrors invert right and left.".

The fact that adaptation is required to correctly localize objects through mirrors does not mean that a perceptual inversion has occurred; it only means that perceptual–motor coordination has been altered and needs to be restored. Experiments with inverting or shifting lenses demonstrate clearly that the optical properties of the medium do not interfere with visual experiences as long as the perceptual medium preserves the structural organization of the incoming light.[9] As Stratton [1896, 1897]'s right–left or Erisman and Kohler [1953, 1958]'s up–down reversal experiments have demonstrated, with practice, subjects gradually adapt to their new optical devices, and they regain almost normal perceptual–motor coordination after several days of training.[10] But what is also remarkable about these experiments is that removing the optical devices doesn't immediately result in a reversion to normal perceptual–motor coordination. The adaptation observed as a result of wearing an optical device persists. It is only after a subsequent period of adaptation that spatial perception is fully restored.

Scientists and philosophers have been fascinated by these experiments, and numerous, often conflicting conclusions have been drawn from the experimental results. The experiments with prisms and mirrors have been discussed in relation to the question of the orientation of the visual field. Although there is not sufficient room here to go into

[9] As stressed by Heider [1959: 3]: "the configuration of light rays which meets my eyes, is coordinated to the object, the stone, in a special way. Even a small change of the surface of the stone changes the stimulus configuration. It is not coordinated to any specific properties of the mediator."

[10] Kohler [1962: 300] writes that "after several weeks of wearing goggles that transposed right and left, one of Erismann's subjects became so at home in his reversed world that he was able to drive a motorcycle through Innsbruck while wearing the goggles".

detail, I would like to suggest that the view of visual media defended here and in Mizrahi [2018] provides a straightforward interpretation of these results. In effect, because there are no inherently adequate or inadequate visual media, it is not surprising that subjects can experience veridical perception while wearing goggles with a displacing or inverting prism. As stressed above, any material that preserves the structure of the incoming light will act as a visual medium and enable visual perception. As with mirrors, the fact that an adaptation is required for a subject to correctly localize the objects he or she perceives does not mean that his or her visual experience is illusory or erroneous. What it shows is that visual and motor frameworks need to be aligned: pointing to an object you perceive in open air and pointing to an object you perceive through mirrors or through prismatic lenses rely on different forms of visual-motor coordination.[11]

Although I have argued that mirrors and refractive lenses do not generate perceptual illusions, they are certainly capable of producing errors and false judgments. The goal of the next section is to account for the errors generated by mirrors and other optical instruments and to explain how a naive-realist approach to perception, which resists the idea that there are genuine illusions and misperceptions, can give a coherent and enlightening account of the errors and misleading appearances associated with specular perception.

7. Naive realism and misleading appearances

[11] Arthadeva [1957: 163-4] rightly points to the fact that specular perception is accused of being illusory only when it is compared to nonspecular perception. When our visual access to reality is restricted to specular perception, as it is in the goggle experiments, the temptation to refer to specular perception as illusory seems to vanish. Here is what he says : "If our eyes are confined to seeing only what the mirror shows us, we shall not doubt we touch the objects, taste them, smell and hear them, when we see ourselves do so. We can live without confusion. The confusion occurs when we see objects by means of reflection and at the same time the same or other objects directly. We are then aware of two worlds of space and we tend to call one real and the other an illusion.".

The theory of perceptual media defended here fits nicely into the most general framework provided by naive realism. According to naive realism, there is no need to introduce representations, sense data, or any mind-dependent entity to explain the phenomenal character of perceptual experiences. According to this view, what we perceive is a fragment of the world itself and its phenomenal character can be explained solely by reference to mind-independent objects and properties. The characterization of perceptual media offered in this paper defends the same model. It explains how perceptual media can affect perceptual experiences without introducing mind-dependent or subjective entities. According to the account of perceptual media defended here, the perceptual variations induced by a change in perceptual media can be accounted for exclusively in terms of mind-independent objects and features.

Although naive realism has many phenomenological and epistemological merits, it also seems to face some serious difficulties. One of them is the possibility of illusions and perceptual errors. In effect, if perceptual experiences are constituted only by mind-independent objects and properties, how can there be illusory or erroneous experiences? How can perceptual experiences be constituted by things that are different from what they really are? Naive realism seems inadequate to explain illusion and misperception, because it does not admit a dichotomy between what things are and how they appear.

As stressed above, mirrors and perceptual media in general are considered a source of many illusions and misperceptions: sticks appear bent in water, germs appear bigger under a microscope, and hands appear reversed in mirrors, to take only a few examples. If naive realism cannot distinguish between veridical and nonveridical perceptual experiences, how can it deal with these apparent cases of illusions? The strategy I have proposed here is to contest the claim that mirrors and other visual media, like water or refractive lenses, generate perceptual illusions. As demonstrated above, all these apparently illusory or erroneous perceptual experiences can be accounted for in terms of

worldly objects and features. What is missing, however, is a plausible account of their misleading character. Although it is possible to deny that germs don't really look bigger under a telescope or that a stick doesn't really look bent when immersed in water, what is not contestable is the fact that people are often fooled by such experiences. With mirrors, these confusions seem to be systematic, as is attested by magicians' use of mirrors to repeatedly fool their audiences and by the requirement that car manufacturers place a warning on passenger-side mirrors that "objects in mirror are closer than they appear."

Misleading appearances have typically been understood as involving illusory or erroneous perceptual experiences, but there are other options. In particular, it is possible to account for misleading appearances in doxastic terms. This view has been defended by Arthadeva [1960] and more recently by Genone [2014]. My goal in this last section is to show how the doxastic approach can be fruitfully applied to misleading appearances generated by mirrors or other perceptual media and how it can benefit from the account of perceptual media I propose.

Perceptual judgments rely on what is accessible through particular perceptual experiences but also on a rich contextual and sensorimotor knowledge. For example, determining whether an object is stationary or moving relies on what is perceived as well as the perceiver's implicit knowledge of his own movements. The predominant role of background knowledge for perceptual judgments is particularly salient in specular perception. As recognized by Casati [2012: 201], the perceiver's awareness of the fact that he or she is dealing with a mirror removes the misleading character associated with specular perception:

> The idea that an "inversion" occurred was an artefact of description: only abstracting from the fact that the reflective properties of mirrors are known (feigning epistemic innocence) could one maintain one had the impression that the hook had moved from the right arm to the left, and that therefore mirrors

> invert right and left. It is not content that is illusory; the illusion is the impression of having illusory content.

Knowing whether or not we are dealing with a mirror seems to determine whether or not we can accurately identify the location of the objects we perceive. The absence of this piece of knowledge therefore seems to be essential to the misleading character associated with specular perception: once we know we are dealing with mirrors, we are less inclined to believe that an object is located behind the mirror or that the magician has really vanished.

A similar account can be given for misleading appearances involved in experiments with refractive lenses or inverting glasses. Refractive lenses and inverting glasses introduce systematic changes in the way visual experiences are related to other sense modalities and to the motor system. An adaptation is therefore required for the subject to align his visual experiences with the information coming from the other senses and to engage in an appropriate behaviour. But the experiments are interesting not only because they reveal what is required to achieve effortless experiences when confronted with nonstandard visual media, but also because they expose the often overlooked complexity of ordinary perception.[12] As stressed by Dokic [2014], perception is commonly accompanied by some control-oriented monitoring that grounds our knowledge about our own perception. So when confronted with visual experiences that differ from ordinary perceptions, the control mechanism, whose function is to monitor visual processes, can either make us aware of the changes produced by new perceptual media or fail to notice those changes. In the first case, the visual experiences will not be prone to generate false belief. In the latter case, they will. Imagine a scenario in which a subject who was not aware that he/she was looking into a mirror suddenly understands

[12] The view defended here is not equivalent to an enactivist view of perception. Although it is argued that perceptual judgments rely on a complex interplay of the different perceptual and motor systems, it does not suppose that visual experiences are *constituted* by motor dispositions.

that there is a mirror in front of him/her. How does this knowledge affect his/her experience? One may be tempted to explain the surprise felt by the perceiver when he/she learns that he/she is standing before a mirror as being caused by a change in his/her visual experience. It could be argued, for example, that when the subject learns that there is a mirror in front of him/her, his/her visual experience changes because he/she suddenly sees the mirror. But if mirrors are not visually perceived, as I have argued here, this interpretation must be rejected. An alternative approach is to explain the phenomenal shift caused by noticing the presence of a mirror in cognitive and metacognitive terms. As stressed by Prinz, the difference experienced before and after noticing the presence of a mirror is not visual; it is explained in terms of the practical skills and cognitive processes exploited by the subject when localizing objects in his surroundings. Although qualitatively identical at the visual level, innocent and noninnocent specular perception differ in their sensorimotor integration:

> The "seeming" here is not visual. The world may look inverted, but relearning motor skills makes it possible to behave as if things had their standard orientation. Compare what happens when you become adept at combing your hair in a mirror. You learn to move your hand backward to reach the back of your head even though the mirror reflection suggests that you should move your arm forward, since the reflected back of your head is in front of you. When you master this skill, the mirror doesn't appear inverted. Likewise, it's natural to say that some things in the mirror's reflection look as if they are behind you, but that doesn't mean that you experience what it's like to see out of the back of your head; it just means that you know from the reflection that they are located to your rear. [Prinz 2012: 177]

8. Conclusion

It is possible to refute the account of specular perception as illusory by arguing that the misleading character is not perceptual but doxastic. When using mirrors, people can

misjudge the location of objects not because their visual experiences are distorted, but because the various sensorimotor mechanisms that ground the way they localize objects in their environment have been altered.

Although the account of specular perception provided here does not constitute a general response to the challenge that illusions pose for naive realism, I believe it provides the naive realist with a new way to tackle this challenge.

Most "visual illusions" are more than just misleading. They are also informative. As stressed in the introduction, mirrors can generate false beliefs, but they also enrich our visual world and our knowledge in general. This apparent paradox is true for all visual media. Magnifying lenses, for example, may cause observers to judge objects to be bigger than they really are, but at the same time they give visual access to a reality too small to be perceived without them. Coloured or polarized lenses may seem to project misleading colours and patterns onto perceived surfaces, but they are also used in laboratories to detect hidden evidence.

To explain how visual experiences can be both misleading and informative, it is crucial to understand in what way misleading appearances differ from "normal" appearances. For instance, why is perceiving a stick partially immersed in water different from perceiving a stick completely immersed in water? Because so-called visual illusions deviate in some way from "normal" visual experiences, most accounts of such illusions consider them erroneous. I have argued against this view and claimed that the deviant aspect of visual illusions should not be interpreted as erroneous but rather as involving a new form of visual access to the world.

Mirrors and prismatic lenses offer new perspectives to observers. Refractive lenses allow observers to perceive objects too small or too distant to be seen with the naked eye. And colour filters give access to colours rarely perceived in standard conditions. Although these experiences are not erroneous, they can be misleading, because they

require subjects to learn how to interpret them correctly. Once the adaptation to a new visual medium is complete and the subject has learned how to deal with what is perceived, the misleading character associated with new visual media vanishes. Unlike our visual system, which we have used since birth, the mastery of telescopes, microscopes, and mirrors requires some practice. And as with all learning processes, mistakes are inevitable.

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