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Trompe l'oeil and the Dorsal/Ventral Account of Picture Perception

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Abstract While there has been a lot of discussion of picture perception both in perceptual psychology and in philosophy, these discussions are driven by very different background assumptions. Nonetheless, it would be mutually beneficial to arrive at an understanding of picture perception that is informed by both the philosophers' and the psychologists' story. The aim of this paper is exactly this: to give an account of picture perception that is valid both as a philosophical and as a psychological account. I argue that seeing *trompe l'oeil* paintings is, just as some philosophers suggested, different from other cases of picture perception. Further, the way our perceptual system functions when seeing *trompe l'oeil* paintings could be an important piece of the psychological explanation of perceiving pictures.

1 *Trompe l'oeil*

Unbiased readers of the philosophical literature on depiction may find it really odd how much of the discussion concentrates on *trompe l'oeil* paintings. These paintings after all, one could be tempted to say, are of a rather peripheral genre, which is confined to a very small geographic region (roughly, France and the Low Countries) and a very narrow time window (roughly, the 18th Century).

While this may be true of *trompe l'oeil* paintings as a sub-genre of still life painting, the effect *trompe l'oeil* paintings are after, namely, to fool us into thinking that we see the depicted object face to face, is much more widespread. It is used widely in ceiling frescos of churches and even in contemporary street art (for example, chalk drawings on sidewalks). 3D effects in cinema could also be argued to be a version of *trompe l'oeil* in this sense.

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Seeing *trompe l'oeil* paintings is a temporally complex process. What normally happens is that we look at a picture, we are fooled into thinking that we see the depicted object and then we realize that we were fooled and see the painting as a *trompe l'oeil* painting—as a painting that just a moment ago fooled us into thinking that we saw the depicted object. Even after this point it is often possible to attend to the picture in a way that would again make us experience the *trompe l'oeil* illusion—to again forget for a moment that we are looking at a picture of the depicted object and not at the depicted object face to face. I will, following the philosophical literature, focus on the first stage of this complex and temporally extended process—the stage where we are fooled into thinking that we see the depicted object face to face. But it needs to be acknowledged that this experience is only part of the overall and very complex experience of our encounter with *trompe l'oeil* paintings.

One reason for the philosophers' obsession with *trompe l'oeil* paintings is without a doubt Richard Wollheim, who famously argued that seeing *trompe l'oeil* paintings is not picture perception—or, as he put it, it is not 'seeing-in'. He has been heavily criticized for this claim, partly because if we put it together with another famous Wollheimian claim, namely, that picture perception explains what pictures are, we arrive at some odd conclusions. Wollheim argued that : pictures are just those object where 'suitably informed observers' (whoever they are) are supposed to undergo a 'seeing-in' experience. But then, given that 'suitably informed observers' are not supposed to undergo a 'seeing-in' experience in the face of *trompe l'oeil* paintings (at least not at the first stage of the complex process of seeing a *trompe l'oeil* picture), it seems to follow that *trompe l'oeil* paintings are not pictures.[1] But they surely hang on the walls of museums next to *bona fide* pictures. Some philosophers thought that this implausible consequences of Wollheim's view clearly shows that he was wrong about *trompe l'oeil* paintings (see Feagin 1998 for a good overview on this).

But why did Wollheim think that seeing *trompe l'oeil* paintings is not picture perception? Because he took to be a necessary condition for picture perception that we are simultaneously aware of the depicted scene and the picture surface. As in the case of seeing *trompe l'oeil* paintings we are clearly not aware of the picture surface (otherwise we would not be fooled), this necessary condition is not satisfied: Wollheim concludes that seeing *trompe l'oeil* paintings, whatever it may amount to, is different from picture perception.

Whether or not Wollheim is right about this, what is important from the point of view of this paper is the contrast between the philosophical emphasis on *trompe l'oeil* and the way *trompe l'oeil* is treated in the psychological literature on picture perception. For the psychologist, *trompe l'oeil* paintings are as valid as a subject of study when it comes to picture perception as any other picture: in the case of *trompe l'oeil* paintings, as in the case of any other pictures, our perceptual apparatus constructs a three dimensional scene out of two dimensional markers. In short, for the psychologist, seeing a *trompe l'oeil* painting is a paradigmatic case of perceiving pictures. For the philosopher, seeing a *trompe l'oeil* painting is always a problem case and, at least for some, it is not a case of perceiving pictures at all.

[1] It is easy to block this conclusion as long as we allow for the temporally complex experience of *trompe l'oeil* pictures, of which only the first stage is the one where we are fooled.

Just why there is such a discrepancy between philosophical and psychological perspectives on picture perception is hard to tell. One possibility is that while psychologists are interested in the way in which our visual system is capable of constructing a three dimensional scene out of a two dimensional array we receive our sensory stimulation from, philosophers are interested in the way in which our awareness of the two dimensional surface of the picture and our awareness of the three dimensional depicted scene interact. Or, even more generally, philosophers are interested in our experience of pictures (and this experience at least often involves the experience of the surface). Psychologists, in contrast, are not really interested in our *experience* of pictures: they are trying to understand the—conscious or unconscious—mechanism by which our perceptual system constructs the three dimensional depicted scene of the picture. So it is possible that the difference between philosophical and psychological perspectives on picture perception is merely that they have different *explananda*: philosophers are trying to explain the experience of seeing pictures whereas psychologists are trying to explain the (conscious or unconscious) mechanism of picture perception. In fact, unconscious picture perception - a phenomenon we have plenty of evidence for (see, e.g., Greenwald et al. 1996; Strahan et al. 2002; Eimer and Schlaghecken 2003) - is oddly missing from philosophical discussions of picture perception.

Whatever the difference, what is important is whether it could it be bridged. As there has been a tremendous amount of discussion of picture perception both in perceptual psychology and in philosophy (especially aesthetics, but also in philosophy of perception), it would seem natural to combine forces to arrive at an understanding of perception that is informed by both the philosophers' and the psychologists' story. The aim of this paper is exactly this: to give an account of picture perception that is valid both as a philosophical and as a psychological account.

I will argue that seeing *trompe l'oeil* paintings is, just as Wollheim suggested, different from other cases of picture perception. So the philosophers are right about stressing the importance of these specific kinds of pictures. Further, the way our perceptual system functions when seeing *trompe l'oeil* paintings could be an important piece of the psychological explanation of perceiving pictures.

2 The Dorsal/Ventral Account of Picture Perception

Here is an account of what goes on in our perceptual system when seeing pictures. Our ventral visual subsystem represents the depicted scene, whereas the dorsal visual subsystem represents the picture surface. Let's go through this more slowly.

We know that talking about *the* visual system is a bit misleading—our visual system (and the visual system of other mammals) is not a unified whole: it consists of two more or less separate visual subsystems: the dorsal and the ventral one. They both originate from the primary visual cortex but proceed in very different parts of the human brain. The main function of the dorsal stream is to help us perform various perceptually guided actions with the perceived objects. The main function of the ventral stream is to help us identify and recognize the perceived objects (see Milner and Goodale 1995; Goodale and Milner 2004, for overview).

While these two subsystems normally work together, they can be, and in the case of some patients, they are, dissociated (although there do not seem to be fully encapsulated (see Franz and Gegenfurtner 2008, Franz et al. 2003, Schenk and McIntosh

2010)). Optic ataxia patients have a more or less intact ventral stream, but a damaged dorsal stream: they are very good at recognizing and identifying objects, but they find it difficult to perform perceptually guided actions with them or even to localize them in their egocentric space. Visual agnosia patients have damage in the ventral stream, but have a relatively intact dorsal stream: they can perform actions remarkably successfully with objects they can't identify or recognize (or even experience in some cases).

But the functioning of the ventral and the dorsal stream can be dissociated even in healthy human subjects—in the case of some optical illusions. One famous example is the 3D Ebbinghaus illusion. The 2D Ebbinghaus illusion is a simple optical illusion, familiar from various perception textbooks and popular science books: if a circle is surrounded by smaller circles, it looks bigger than a circle of the same size that is surrounded by larger circles. The experienced size of the circle depends on the context we see it in—if it is surrounded by larger circles, we experience it as smaller. If it is surrounded by smaller circles, we experience it as bigger. The 3D Ebbinghaus illusion is the very same illusion, in 3D, that is, with poker chips instead of circles. The experienced size of the poker chip depends on the context we see it in—if it is surrounded by larger poker chips, we experience it as smaller. If it is surrounded by smaller circles, we experience it as bigger. But, and here is the surprising finding, if we are asked to reach out to pick up this poker chip, the grip size we approach it with is not (or only very mildly) influenced by the illusion. As it has been evocatively put, this optical illusion deceives the eye, but not the hand (Aglioti et al. 1995). The standard explanation for this effect is that while our ventral stream is deceived by this illusion and leads to the experience of the two poker chips as having different size, our dorsal stream is not deceived (or is much less deceived)—it leads to the dorsal representation of the size-properties of the poker chip as more or less the same (Aglioti et al. 1995, see also Milner and Goodale 1995, chapter 6, Vishton and Cutting 1995 and Goodale and Milner 2004). Similar results can be reproduced in the case of other optical illusions, like the Müller-Lyer illusion (Goodale&Humphrey 1998; Gentilucci et al. 1996; Daprati and Gentilucci 1997; Bruno 2001), the 'Kanizsa compression illusion' (Bruno and Bernardis 2002), the dot-in-frame illusion (Bridgeman et al., 1997), the Ponzo illusion (Jackson and Shaw 2000, Gonzalez et al. 2008) and the 'hollow face illusion' (Króliczak et al. 2006).[2]

In sum, sometimes the ventral stream and the dorsal stream attribute very different size properties to the very same object. The main claim of the dorsal/ventral account of picture perception is that this is also what happens each time we perceive pictures: our dorsal stream attributes properties to the picture surface and our ventral stream attributes properties to the depicted scene (Nanay 2008, 2010, 2011, 2014). I elaborate on

[2] I focused on the 3D Ebbinghaus illiusion because of the simplicity of the results, but it needs to be noted that the experimental conditions of this experiment have been criticized recently. The main line of criticism is that experimental design of the grasping experiment and the perceptual judgment experiment is very different. When the subjects grasp the middle chip, there is only one middle chip, surrounded by either smaller or larger chips. When they are judging the size of the middle chip, however, they are comparing two chips – one surrounded by smaller chips, the other by larger ones (Pavani et al. 1999, Franz 2001, 2003, Franz et al. 2000, 2003, see also Gillam 1998, Vishton 2004 and Vishton and Fabre 2003, but see Haffenden and Goodale 1998 and Haffenden et al. 2001 for a response). See Briscoe 2008 for a good philosophically sensitive overview of this question. Those who are moved by Franz et al. style considerations can substitute some other visual illusion, namely, the Müller-Lyer illusion, the Ponzo illusion, the hollow face illusion or the Kanizsa compression illusion, where there is evidence that the illusion influences our perceptual judgments, but not our perceptually-guided actions.

this account first as a psychological theory of picture perception and then as a philosophical one.

3 The Dorsal/Ventral Account of Picture Perception as a Psychological Theory

What makes the dorsal/ventral account of picture perception a plausible psychological theory of picture perception? The main question most psychological accounts of picture perception are interested in is understanding the mechanisms by means of which our perceptual system constructs the three dimensional depicted scene on the basis of two dimensional markers (see, e.g., Goldstein 1987, 2001 for summary). The dorsal/ventral account of picture perception addresses this very problem and answers that in order to understand this phenomenon we need to talk both the ventral and the dorsal visual subsystems into considerations that do very different things in this process: one represents the features of the picture surface, whereas the other represents features of the three dimensional scene.

Here is a set of empirical findings that supports the dorsal/ventral account of picture perception. One way in which psychological theories of picture perception are testable is by focusing on subjects who, because some damage in their perceptual system, are incapable of perceiving pictures. If, as the dorsal/ventral account of picture perception suggests, both the ventral and the dorsal visual subsystems are needed in order for us to perceive pictures, then we should expect problems with picture perception both when the dorsal system is malfunctioning, but the ventral stream is intact and in the converse cases, when the ventral stream is malfunctioning and the dorsal stream is intact.[3]

And this is exactly what the findings show. The easier case is the latter: it is well-documented that visual agnosia patients (that is, patients with lesions in their ventral stream) are incapable of seeing things in pictures (see Turnbull et al. 2004 and Westwood et al. 2002). D. M., one such patient, can copy the two dimensional lines of a picture but she cannot tell whether these two dimensional lines depict an impossible object. Further, she is not subject to optical illusions (for example, the Müller-Lyer illusion and the Ponzo illusion) that are usually taken to presuppose our ability to see three dimensional objects in two dimensional figures (Turnbull et al. 2004). So it seems uncontroversial that the malfunctioning of the ventral stream leads to the malfunctioning of one's abilities to perceive pictures.

Things are a little more complicated when it comes to optic ataxia patients (that is, patients with lesions in their dorsal stream). Optic ataxia patients tend to cope remarkably well with their environment—the malfunctioning of the dorsal stream is only manifest under some special circumstances as it is compensated by the ventral stream in many tasks. Further, as these patients have been growing up in a world full of pictures, it seems unlikely that they wouldn't acquire a non-dorsal way of recognizing *that* they perceive a picture. The picture perception of optic ataxia patients is more difficult to assess than that of visual agnosia patients.

But there is an important empirical study that demonstrates that optic ataxia patients do not have normal picture perception abilities. A patient presenting symptoms of optic ataxia, A.T., who sustained a bilateral parieto-occipial infarct during eclampsia did

[3] I want to leave open the question about just what 'malfunctioning' means here. Different degrees of malfunctioning presumably lead to different problems with picture perception.

perceive pictures, could tell pictures of apples from apples themselves, she could recognize depicted apples, etc. However, her "evaluation of line length and size of drawn figures was poor" (Jeannerod et al. 1994, p. 370, see also Jeannerod 1997, p. 62). In other words, while she knows *that* she perceives a picture, her actual picture perception abilities are malfunctioning as a result of the malfunctioning of her dorsal stream. The malfunctioning of the dorsal stream does not result in the complete breakdown of picture perception (like the malfunctioning of the ventral stream does), but it does lead to misestimating the distances and size of the depicted scenes. In short, these empirical findings confirm the predictions of the dorsal/ventral account of picture perception—if the mechanism that is responsible for picture perception makes heavy use of both the ventral and the dorsal visual subsystems, then we should expect that the malfunctioning of either of these would lead to difficulties (and different difficulties) in picture perception. And this is exactly what the empirical findings confirm.

Now, there is a somewhat uncomfortable asymmetry between the picture perception capacities of visual agnosia and optic ataxia patients: visual agnosia patients' picture perception seems much more impaired than optic ataxia patients'. I tried to explain this asymmetry with reference to the fact that optic ataxia patients, having grown up in a world full of pictures, do see *that* they see a picture, even if they do not strictly speaking see anything *in* the picture. But more research is needed to be done here. In fact, one way in which the dorsal/ventral account of picture perception can be tested is by a close examination of the picture perception abilities of optic ataxia patients. While seeing that one is looking at a picture and seeing something in a picture may lead to similar behaviour in general, the two ways of relating to pictures is still possible to tease apart in experimental conditions. One possible way of doing so would be by, maybe unsurprisingly in the light of the context of this paper, focusing on *trompe l'oeil* pictures: if one's engagement with pictures is restricted to seeing that one is looking at a picture, this will not make a difference when it comes to the distinction between perceiving *trompe l'oeil* and non-*trompe l'oeil* pictures. If, in contrast, one can genuinely see things in pictures, this will make one's experience of a *trompe l'oeil* picture very different from that of a non-*trompe l'oeil* picture.

So far, I argued that findings from optic ataxia and visual agnosia patients indicate that both visual subsystems are involved in picture perception. The question is: how. And some other empirical results could help here. We have seen that according to the dorsal/ventral account of picture perception, the dorsal visual subsystem represents the features of the picture surface, whereas the ventral visual subsystem represents the features of the depicted scene. The latter claim doesn't seem too controversial: as the ventral stream is responsible for the identification and recognition of objects and we can reliably recognize and identify depicted objects, it follows that the ventral stream is involved in representing the depicted objects. It also seems clear that features of the picture surface are not normally represented ventrally: we do not normally recognize and identify features of the picture surface when perceiving pictures. We *can* do so, when prompted or when admiring the brushstrokes responsible for the depicted objects, but representing these features ventrally is certainly not something that is necessary for picture perception (see Clark 1960, p. 17, pp 26–27). In short, it seems uncontroversial that the depicted scene, but not the picture surface is what is ventrally represented.

The involvement of the dorsal stream is much more difficult to assess, partly because dorsal vision is normally (maybe necessarily—I want to bypass this debate, but see

Dehaene et al. 1998; Jeannerod 1997; Jacob and Jeannerod 2003; Brogaard 2011; Briscoe 2008; Milner and Goodale 2008; Jeannerod and Jacob 2005, Goodale 2011, Clark 2009, Kravitz et al. 2011) unconscious. The dorsal/ventral account of picture perception makes two claims about the involvement of the dorsal stream in picture perception: First, the features of the picture surface are dorsally represented. Second, features of the depicted scene are not (normally) dorsally represented. I'll start with the former claim.

A simple consideration for this claim is that we normally have no problem touching the surface of pictures we see when prompted. But as touching is a perceptually guided action that is based on the functioning of the dorsal stream, it seems uncontroversial that our dorsal stream does represent the surface of the picture—otherwise it could not guide our touching action successfully.

But there is another argument for the claim that the picture surface is dorsally represented—one that makes use of a widely discussed topic in the psychology of picture perception: the perception of pictures from an oblique angle. An odd fact about the psychology of picture perception is that if our position changes in front of the picture, our view of the depicted object does not change (Vishwanath et al. 2005; Pirenne 1970; Polanyi 1970; Sedgwick and Nicholls 1993; Wollheim 1980, pp. 215–216, Matthen 2005, pp. 315–317). Even if we look at a picture from an oblique angle, we don't see it as distorted. This is surprising and needs to be explained, as the projection of the depicted object on our retina is very different from the way it is when we look at the picture head on.

The standard way of explaining this phenomenon is to say that we are perceptually aware of the orientation of the picture surface and this awareness compensates for the oblique view: that is why we do not see the depicted object as distorted (Pirenne 1970, pp. 99f). What is interesting from our point of view is that there are cases where there is no such compensation. When we are looking at ceiling frescos from an oblique angle, for example, we do see the depicted scene as distorted. So what is the difference? Pirenne's original suggestion is that we do not have perceptual access to the orientation of the surface of the fresco, because it is too far away. When (because of the crowd) we are looking at the Mona Lisa from an oblique angle, however, we do have perceptual access to the orientation of the picture surface, which allows our perceptual system to compensate for the oblique view: our experience of the depicted scene is not distorted. Any explanation for the oblique perception of pictures needs to be able to tell not only why our perception of the Mona Lisa is not distorted but also why our perception of the distant fresco is distorted.

So far, I have pretended that Pirenne's analysis of the 'compensation' for the oblique point of view is uncontroversial. It is not. If Pirenne were right, then perceptual access to the orientation of the surface would be necessary and sufficient for compensating for the oblique angle and thus, for not experiencing the depicted scene in a distorted manner. But both the necessity and the sufficiency claims have been questioned. It seems that even if all the cues that indicate the orientation of the picture surface are artificially removed, we still experience the depicted scene without any distortions (Busey et al. 1990). Further, it has also been argued that even if we do have cues that indicate the orientation of the picture surface, we sometimes do experience a distorted depicted scene (Halloran 1989). It needs to be noted that these two experiments are not considered conclusive (see Busey et al. 1990; Halloran 1989; Rogers 1995; Topper 2000 and Kulvicki 2006 for a summary; as Koenderink et al. 2004, p. 526 summarizes,

"there appears to be some (weak) consensus that no 'correction' is applied to pictorial space due to obliquely viewed pictures" (see also Maynard 1996, p. 33).

But the 'compensation' view, and the possibility of explaining what we experience when we look at pictures from an oblique angle, could be salvaged if we introduce a distinction between having ventral perceptual access to the orientation of the picture surface and having dorsal perceptual access to it. We need to differentiate between two versions of the 'compensation' view: (i) our ventral representation of the orientation of the picture surface compensates for the oblique view and (ii) our dorsal representation of the orientation of the picture surface compensates for the oblique view.

Dorsal and ventral representation of the orientation of the picture surface comes apart in the usual ways: the latter feeds into our recognitional abilities whereas the former helps us to localize objects in our egocentric space and to interact with them. The arguments against the 'compensation' view I quoted above are arguments against (i): against the claim that 'compensation' entails *ventral* access to the orientation of the picture surface. To use just one example, in the experiment that is supposed to show that we do 'compensate' even without perceptual cues about the orientation of the picture surface, these cues are cues that are ventrally represented (the 'double projection technique' that Busey et al. 1990 use for removing these cues would remove ventral cues only: cues the perception of which feeds into our recognitional apparatus, see the discussion in Cutting 1987 and Busey et al. 1990, p. 2). Thus, what this experiment really shows is that our ventral perceptual access to the orientation of the picture surface is not necessary for experiencing the depicted scene without any distortion.

My proposal is that we should reject (i) and accept (ii): we should interpret our perceptual access to the orientation of the picture surface as a dorsal phenomenon: if we do so, we do not face any of the objections outlined above and we can indeed use Pirenne's original observations to explain what we experience when we look at pictures from an oblique angle.

But remember that we are supposed to explain not only why our perception of pictures is not distorted when we are looking at pictures from an oblique angle. We are also supposed to explain why and when our perception of pictures *is* distorted. To go back to Pirenne's original fresco example, when we are looking at a ceiling fresco from an angle, we do experience the depicted scene as distorted. What is the difference? If we accept (ii), the hypothesis that our awareness of the orientation of picture surfaces is dorsal awareness, then we have a straightforward explanation. When we are looking at a ceiling fresco from an angle, we are lacking *dorsal* access to the orientation of the fresco—the fresco is too far away for our dorsal subsystem to allow localization in our (egocentric) space: the dorsal susbsystem is famously very bad at representing objects that are too far away (see Matthen 2005 for a summary).

Some empirical studies also seem to support this hypothesis. In a recent article, Vishwanath et al. 2005 argued for a version of the 'compensation' view, where they describe our perceptual access to the orientation of the picture surface as access to the 'local slant' of various points of interest on the picture surface. Although the authors do not raise the question whether 'local slant' is dorsally or ventrally represented, the fact that the representation of the 'local slant' of one point of the surface is insensitive to (or, as they put it, "not contaminated by") both picture content and the 'local slant' of other points of the surface suggests that it is dorsally represented. Why? Because dorsal (but not ventral) vision is taken to attribute properties 'locally', that is, in a way that is

insensitive to the properties attributed to other parts of the perceived scene, as the experiments on optical illusions I mentioned in Section II show (see also Jeannerod 1997; Goodale and Milner 2004).

Thus, we have good reason to suppose that our perceptual access to the orientation of the picture surface is dorsal. If we take our perceptual access to the picture surface to be dorsal, we can explain both why oblique view of pictures is not distorted and why under some circumstances (when the surface is too far away) it is distorted. If we take it to be ventral access, both of these explanations become problematic. Thus, we have good reason to accept (ii) over (i). And this is exactly what we need in order to support the claim that the picture surface is represented not by the ventral but by the dorsal subsystem.

Finally, is the depicted scene represented dorsally? I want to bracket this claim until Section V below, because this is a question that will loom large in the discussion of seeing *trompe l'oeil* paintings (where the depicted scene is, for a split second, represented dorsally), but it is important to point out that at least in the case of normal (non-*trompe l'oeil*) pictures, the answer is usually negative: when we see *Mona Lisa*, the depicted face is unlikely to be represented dorsally. Dorsal vision is supposed to help us perform perceptually guided actions. But we don't and can't perform actions on depicted objects. Further, a minimal condition on performing perceptually guided actions on objects is representing the spatial location of this object in one's egocentric space: as in front of us, or to our left, etc. If we couldn't represent the spatial location of an object in our egocentric space, then we would have no idea which direction to reach out to grab it or use it for any other action. But, crucially, depicted objects are not represented in our egocentric space: the depicted space is not our egocentric space. And while we may represent the depicted objects as having a spatial location in the depicted space, we can't represent them as having a spatial location in our egocentric space. There is no fact of the matter about the distance between the perceiver and the depicted object. If I see a picture of an apple, there is always a fact of the matter about how far away the surface of the picture is from me, but there is no fact of the matter about how far away the depicted apple is from me. It is not represented as having an egocentric spatial location—thus, it is not represented dorsally (as we shall see in Section V, things get a bit more complicated when it comes to *trompe l'oeil* paintings).

Further, research on Capgras and Fregoli patients show that the feeling of presence is likely to be a dorsal phenomenon (Ellis and Young 1990, see also Matthen 2005, Chapter 13 and Dokic 2010 for philosophical analyses). When the dorsal stream is impaired, the patients' sense feeling of presence is either missing (as in the case of Capgras patients, who accuse their loved ones of being impostors because they lack the feeling of presence when looking at them) or is overactive (as in the case of Fregoli patients who see familiar people in disguise in complete strangers) (see Coltheart and Davies 2000 and Coltheart 2007). In normal cases of picture perception, we do not seem to experience any feeling of presence of the depicted object. And this suggests that the dorsal representation is missing. Again, it is important to emphasize that this only applies to normal cases of picture perception. As we shall see in Section V, in the case of seeing *trompe l'oeil* pictures, we seem to represent the depicted object dorsally—and this is very much in tune with the enhanced feeling of presence of the objects depicted in *trompe l'oeil* pictures.

To sum up, when we see things in pictures, the depicted scene is not normally represented dorsally (but it can be, for example in the case of perceiving *trompe l'oeil* pictures). And the surface is not normally represented ventrally (but it can be, for example, when we are attending to the brushstrokes of a picture, or to how the brushstrokes give rise to the depicted object). The dorsal/ventral account of picture perception is a genuine psychological theory—it predicts various empirical findings that seem to have been confirmed and its two main claims (about what features are dorsally represented and what are ventrally represented) are empirically motivated. And it gives a detailed explanation for what parts of the visual system are responsible for our capacity to perceive pictures. The question we should now turn to is how the dorsal/ventral account of picture perception stands up as a philosophical theory.

4 The Dorsal/Ventral Account of Picture Perception as a Philosophical Theory

The starting point of many philosophical theories of picture perception is the question of depiction: the question of what makes pictures pictures. Some objects in the worlds are pictures, some others are not. What is the difference between these two groups of objects? One (not the only one, see, e.g., Peacocke 1987, Goodman 1968) way of answering this question is to ask whether there is anything distinctive about our perception of pictures. If there is, then we can define pictures in terms of this distinctive perceptual state: pictures are just those things that when we (or some suitably informed spectators) see them, we (are supposed to) have this distinctive perceptual state.

Thus the question about depiction becomes one about this distinctive perceptual state of picture perception. What, then is so distinctive about this perceptual state? And this is a philosophically significant question even if one chooses to give another, non-experiential, account of what makes pictures (e.g., Goodman 1968). There are various proposals. Ernst Gombrich suggested that when we are in this distinctive perceptual state, our awareness alternates between the picture surface and the depicted scene (Gombrich 1960). Richard Wollheim, in contrast, argued that this distinctive perceptual state is that of simultaneous visual awareness of both the picture surface and the depicted scene. Here is a representative quote:

> The spectator is, and remains, visually aware not only of what is represented but also of the surface qualities of the representation. (Wollheim 1980, p. 214–215).

What this claim amounts to, of course, depends on how one makes sense of the concept of 'visual awareness' Wollheim uses here. Conceived of as a philosophical theory, the dorsal/ventral account of picture perception can and does contribute to this debate by giving a version of Wollheim's view that is not susceptible to various criticisms that have been raised against Wollheim's approach.

Wollheim describes the simultaneous awareness of both the picture surface and the depicted scene as a *twofold* experience. Therefore, according to him, twofoldness of experience is a necessary condition for picture perception. This concept of 'twofoldness' became a widely discussed and widely, but perhaps less widely endorsed, concept (Walton 1990, pp. 300–301, Walton 2002, p. 33, and see Nanay 2004 on the differences between Walton's and Wollheim's concept of twofoldness,

see also Hopkins 1998, esp. pp. 15–17, Maynard 1994, esp. pp. 158–159, see also Lopes 2005, chapter 1 and Kulvicki 2006, pp. 172–173 for moderately critical overviews).

But it is not clear what this concept means, partly because Wollheim uses it in two very different ways (see Nanay 2005). On the one hand, he argues that twofoldness is a necessary condition for perceiving pictures, that is, any picture, regardless of its aesthetic value. On the other hand, he also talks about twofoldness as an important (maybe even necessary) feature of the aesthetic appreciation of pictorial masterpieces. These two ways of using the concept of twofoldness are clearly not the same, but Wollheim unfortunately uses them interchangeably. So some disambiguation is needed. I will make a distinction between the concept of *pictorial* twofoldness and the concept of *appreciative* twofoldness. Pictorial twofoldness is a necessary condition for perceiving pictures—any picture. And appreciative twofoldness is the one that is an important feature of the aesthetic appreciation of pictorial masterpieces.

Part of the confusion between these two ways of using the concept of twofoldness stems from the ambiguity in Wollheim's use of the concept of awareness when talking about twofoldness as simultaneous awareness of the picture surface and the depicted scene (Wollheim 1980, p. 214–215, Wollheim 1998, p. 221 and Wollheim 1987, p. 46). If what is meant by awareness here is conscious attention (as Wollheim sometimes explicitly suggests, see, for example, Wollheim 1980, p. 213), then it is extremely implausible that the resulting concept of twofoldness could serve as a necessary condition for perceiving pictures—we do not usually paying much conscious attention to the features of the picture surface when we leaf through a magazine or watch sitcoms on the plane. But we do, arguably, have such twofold attention (in the sense of appreciative twofoldness) when we are admiring masterpieces and of how certain brushstrokes contribute to the depicted scene. This is the sense of twofoldness, that is, appreciative twofoldness, that Wollheim uses when he makes claims such as "[i]n Titian, in Vermeer, in Manet we are led to marvel endlessly at the way in which line or brushstroke or expanse of colour is exploited to render effects or establish analogies that can only be identified representationally" (Wollheim 1980, p. 218). This concept of appreciative twofoldness (or a version thereof) has been recently discussed under the heading of 'inflection' (Lopes 2005; Podro 1991, 1998; Hopkins 2010; Nanay 2010).

But my focus here is not appreciative twofoldness, but pictorial twofoldness. Pictorial twofoldness, as we have seen, is supposed to be a necessary condition for the perception of pictures. Not only the aesthetic appreciation of masterpieces (or for our 'marvelling endlessly' at them), but for the mere perception of all pictures. And here Wollheim probably should have avoided using the concept of awareness as awareness seems to imply conscious awareness and, as we have seen, we can perceive pictures unconsciously. For neutrality, I will replace his concept of awareness with the more neutral concept of representation. Thus, pictorial twofoldness is a feature of our perceptual states where the perceiver simultaneously represents both the picture surface and the depicted scene. My (somewhat charitable) interpretation of Wollheim's central claim about picture perception is that pictorial twofoldness, conceived this way, is necessary for picture perception.

One may wonder just how charitable this interpretation is. It may be too charitable, but there are signs that Wollheim did use the concept of twofoldness in this sense, at least when he argued (Wollheim 1980, pp. 215–216) that it is this twofold nature of

picture perception that explains the phenomenon that I discussed at great length in the previous section, namely, that our view of the depicted scene does not change if our position in front of the picture changes. Wollheim intends these considerations as an argument for the claim that twofoldness is necessary for picture perception and it is clear that here twofoldness means pictorial twofoldness and that this argument is supposed to apply to all pictures and not only to Titians, Vermeers and Manets.

The disambiguation between pictorial twofoldness from appreciative twofoldness helps us to address one of the most widely mentioned objection to Wollheim's account, namely, that while our experience of some pictures (or some of our experience of pictures) may indeed be twofold, this is very unlikely to be true of all of our experience of all pictures (Levinson 1998, p. 229; Lopes 1996, pp. 37–51). In response it can be pointed out that while this objection is true of appreciative twofoldness (only our experience of some pictures is twofold in this sense), it is not true of pictorial twofoldness.

And the shift from simultaneous awareness to simultaneous representation (conscious or unconscious) helps us with both the generality of the necessary condition when it comes to unconscious picture perception and with yet another influential argument against Wollheim's twofoldness claim (Hopkins 2010, 2012). Robert Hopkins argues that "ordinary pictorial experience is neither disjoint nor contradictory" (Hopkins 2012, p. 2). But it would follow from Wollheim's claim that our pictorial experience is disjoint or contradictory. Therefore, Wollheim's claim is false. Hopkins may be right about the concept of appreciative twofoldness, understood as simultaneous attention. If we are simultaneously attending to both the depicted scene and the picture surface, then there seems to be something contradictory or disjoint about our simultaneous experience of both of these. But, crucially, this objection does not apply if pictorial twofoldness is understood not as simultaneous attention, but as simultaneous (conscious or unconscious) representations.

And here the dorsal/ventral account of picture perception can fill in the details of pictorial twofoldness that Wollheim left unspecified. As we have seen, according to the dorsal/ventral account of picture perception, the picture surface is represented by dorsal vision, whereas the depicted scene is represented by ventral vision. This is a version of pictorial twofoldness: both the picture surface and the depicted scene are represented simultaneously—one by the dorsal stream and the other by the ventral one. And, given that dorsal vision is normally (maybe even necessarily) unconscious, Hopkins's considerations about the alleged disjoint or contradictory nature of twofold perception does not follow. As one of the two folds of our twofold perception of pictures is not conscious, there is no reason to suppose that our experience of pictures according to this account would be disjoint or contradictory.

In other words, the dorsal/ventral account of picture perception could be thought of as providing a version of Wollheim's claim that twofoldness (understood as pictorial twofoldness) is necessary for picture perception. It is, therefore, a genuine philosophical theory of picture perception. In fact, I argued that it provides a less problematic version of Wollheim's very much philosophical theory of picture perception than any other versions.

One may wonder about how faithful this account is to the original concept of twofoldness. After all, I am talking about the dorsal representation of the surface and the ventral representation of the depicted scene. And this sounds like two different

representations and not one representation with two 'folds'. Note, however, that the surface and the depicted scene is one single visual object (or, as some put it, one single 'sensory individual', see Cohen 2004, Nanay 2013). We cannot look at the depicted object without also looking at the surface. In fact, one way of putting the general philosophical problem of picture perception is that when we are looking at a picture, we seem to see two different things (the surface and the depicted scene)—but there is really only one visual object there—how is this duality possible then? It is in this sense that in the case of seeing things in pictures, we have one twofold representation (and not two 'onefold' representations).

My aim was to give an account of picture perception that works both as a psychologicval and as a philosophical theory. Given the odd miscommunication between philosophical and psychological discussions of picture perception, this may sound unlikely. In order to see how the psychological and the philosophical perspectives can be combined, I will now go back to what emerged as a prime example for the disagreements between the psychological and philosophical approaches to picture perception: *trompe l'oeil* paintings.

5 Back to *Trompe l'oeil*

We have seen that philosophical approaches to picture perception tend to emphasize the differences between seeing *trompe l'oeil* paintings and genuine cases of picture perception. Psychological approaches, in contrast, tend to consider seeing *trompe l'oeil* paintings as a prime example for picture perception. This discrepancy is a real challenge for any account of picture perception, like the one I put forward here, that poses both as a philosophical and a psychological theory. What can then the dorsal/ventral account of picture perception say about seeing *trompe l'oeil* paintings? The challenge is even more serious given that the most important proponent of the view that seeing *trompe l'oeil* paintings is not a case of perceiving pictures was Richard Wollheim whose account the dorsal/ventral account of picture perception is supposed to be an elaboration of—as we have seen in the last section.

When we see *trompe l'oeil* paintings and are deceived by them, our ventral stream still represents the depicted objects, as in the case of other instances of picture perception. But, and here is the difference between seeing *trompe l'oeil* paintings and perceiving other pictures, our dorsal stream *also* represents the depicted objects. We have seen that normally, the dorsal stream does not represent the depicted object: we do not (and cannot) represent the depicted object as having a spatial location in our egocentric space: we represent it as having a spatial location in the depicted space. But seeing (and being deceived by) *trompe l'oeil* paintings is different. In these cases, we do (mistakenly) represent the depicted object as having a spatial location in our egocentric space. If we were asked to touch the depicted object, we would attempt to reach through the canvas to where we represent the depicted object as being. It seems that when we see *trompe l'oeil* paintings (and are deceived by them), we dorsally as well as ventrally represent the depicted object.

Does this mean that the picture surface is not represented dorsally when we see *trompe l'oeil* paintings? While I want to remain uncommitted about this, some empirical findings suggest that it is not. It has been shown that there is a significant difference

between our judgment of the size of a perceived object if this object is depicted (even in a *trompe l'oeil* way) and our judgment when we see the same object through a glass, screen or colored glass (see Hagen et al. 1978). This finding strongly suggests that we do represent the picture surface dorsally even when we see *trompe l'oeil* paintings.

So it seems that in the case of seeing, and being deceived by, *trompe l'oeil* paintings, we represent both the picture surface and the depicted object dorsally and we also represent the depicted object ventrally (but presumably we don't represent the picture surface ventrally). Where does this leave us in terms of the clash between the philosophical and psychological approaches to seeing *trompe l'oeil*? On the one hand, the psychologists seems to be right that seeing *trompe l'oeil* paintings is a case of perceiving pictures: the picture surface is represented dorsally, whereas the depicted scene is represented ventrally. But, on the other hand, the philosophers are also right: there is a significant difference between seeing *trompe l'oeil* paintings and other instances of perceiving pictures: in the former, but not the latter cases, our dorsal visual subsystem (also) represents the depicted objects. And this difference is one that the psychological approaches to picture perception should also take into account as there seems to be an important difference in the way our perceptual system constructs the three dimensional depicted scene in the case of *trompe l'oeil* paintings and other pictures: the former involves the dorsal representation of the depicted scene, whereas the latter does not.

This discussion of the ways in which the dorsal/ventral account of picture perception can be applied to the problem case of *trompe l'oeil* shows what an account of picture perception that is both a philosophical and a psychological theory can achieve: it can fill in the details of a general philosophical account of picture perception (like Wollheim's) with the help of some empirical findings (like the dorsal/ventral distinction) and it can also use the philosophical distinctions to highlight empirically important differences (like the one between the functioning of the dorsal stream in the case of seeing *trompe l'oeil* paintings and other cases of picture perception). An account of picture perception that is both a philosophical and a psychological theory can facilitate a two-way interaction between the empirical sciences and philosophy—making the study of picture perception truly interdisciplinary. The dorsal/ventral account I outlined here is supposed to be such an account.

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