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Perception and imagination: amodal perception as mental imagery

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Abstract When we see an object, we also represent those parts of it that are not visible. The question is how we represent them: this is the problem of amodal perception. I will consider three possible accounts: (a) we see them, (b) we have non-perceptual beliefs about them and (c) we have immediate perceptual access to them, and point out that all of these views face both empirical and conceptual objections. I suggest and defend a fourth account, according to which we represent the occluded parts of perceived objects by means of mental imagery. This conclusion could be thought of as a (weak) version of the Strawsonian dictum, according to which "imagination is a necessary ingredient of perception itself".

Keywords Perception · Amodal perception · Mental imagery · Attention

1 A Strawsonian introduction: perception and imagination revisited

The relation between perception and imagination can be analyzed in a variety of ways. First, perceiving and imagining are quite similar in many respects: imagining or visualizing a green chair has similar phenomenal character as seeing a green chair. On the other hand, there are important phenomenal differences between these two mental states, which need to be explained, maybe in terms of intensity or determinacy. An important aspect of any account of imagination (or of perception) is to point out why it is similar to, and how it differs from perception (or from imagination).

In this paper, I will explore the possibilities of arguing for a much stronger connection between perception and imagination. Peter Strawson famously said that

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imagination is "a necessary ingredient of perception itself" (Strawson 1974, p. 54).[1] In fact, he makes two claims about the connection between perception and imagination:

(i) Perceiving a particular object as identical to the same particular object five seconds ago requires imagination.
(ii) Perceiving a particular object as an X (as belonging to the same type as some other particular objects) also requires imagination.

Strawson claims that "the actual occurent perception of an enduring object as an object of a certain kind, or as a particular object of that kind, is […] soaked with or animated by or infused with—the metaphors are *à choix*—[imagination]" (Strawson 1974, p. 53).

I do not want to endorse this claim as a general proposal (partly because it is difficult to see how these metaphors are supposed to be interpreted). However, I will present an argument for a much weaker claim that could be interpreted as a version of the Strawsonian thesis about perception and imagination.

My claim is not that imagination is necessary for perception *per se*, but that the exercise of mental imagery is necessary for amodal perception: for the representation of those parts of the perceived objects that are not visible. In other words, the way we represent the occluded parts of perceived objects is by means of mental imagery. As perception *per se* almost always presupposes amodal perception, this means that the exercise of mental imagery is necessary not only for amodal perception, but also for most cases of perception. Mental imagery is indeed "a necessary ingredient of perception itself".

2 Amodal perception: a central case for any theory of perception

How do we represent the occluded parts of objects we are looking at? Suppose that I am looking at a cat behind a picket fence, but the cat's tail is not visible, because it is occluded by one of the pickets. This scenario is usually described, somewhat misleadingly, as an example of 'amodal perception': I represent the cat's tail (maybe even represent it perceptually, in some sense), but none of my sense modalities carry information about it. Amodal perception is the representation of occluded parts of perceived objects.

The question is how I represent the cat's tail. Do I see it? Do I have a non-perceptual belief about it? Maybe neither?

We need to differentiate three different questions we can ask about our perception of the cat behind the fence. I will try to answer the third of these, but in order to avoid misunderstandings, I need to make it clear what I am not trying to explain.

First, I am not trying to solve the old philosophical puzzle about what the object of our perception is. A question that is often raised in connection with objects occluding one another, such as the cat's tail behind the fence is about the object of

[1] This metaphor and the quote are originally from Kant (Critique of Pure Reason, A120, footnote a).

our perception: what is it that we perceive (Clarke 1965; Strawson 1979; Noë 2004, p. 76). Do we perceive the entire cat? Or those parts of the cat that are visible, that is, a tailless cat? I do not intend to answer any of these questions here. My question is not about *what* we perceive but about *the way in which we represent* those parts of objects that are not visible to us.

Second, I am not trying to answer how it is that the cat's tail is 'perceptually present' to us (I will come back to this question briefly in Sect. 8 though). It is not entirely clear what is meant by perceptual presence, but a rough approximation is this: the cat's tail is perceptually present to me if what it is like to be aware of the cat's occluded tail is similar to what it is like to perceive those parts of the cat that are in view. Thus, the second question is about the phenomenal character of our experience.

The question I will address is not about phenomenal character, but about representation: how do we represent the cat's tail?[2] Phenomenal character and representation comes apart in the usual ways (Van Gulick 1995): we can represent the cat's tail unconsciously and, as we shall see in Sect. 5, it has been claimed that we can be aware of the cat's tail without representing it. Thus, it is important to keep in mind that the topic of this paper is how we *represent* occluded parts of perceived objects.

I will consider three possible answers, point out that they all face serious objections and then propose an alternative that may fare better than the rival theories. My claim is that we represent the cat's tail by means of mental imagery.

I will mainly use visual examples and I will talk about amodal perception as seeing occluded parts of objects. But amodal perception is not an exclusively visual phenomenon—it is very important in the tactile sense modality, for example: when we hold a glass, we represent (amodally) those parts of the glass that we do not have any tactile contact with.[3] All the arguments I give in this paper can be extended to non-visual sense modalities.

Further, although amodal perception in the visual sense modality is usually defined in terms of occlusion: the perception of occluded parts of perceived objects, this characterization does not seem general enough.[4] Take partial illumination. When light is streaming down from a grate above the observer, the objects are illuminated by bands of light. There is no occlusion, yet, we see the object in the same way as we see the cat behind the picket fence. Another example involves shadows: examples of amodal completion (see, for example Figs. 1 and 2) could be reproduced with shadows. But shadows do not occlude one another. In order to allow for examples of partial illumination and shadows (and in order to allow for amodal perception in non-visual sense modalities), we should define amodal perception in terms of the lack of sensory stimulation. We perceive a part of a (perceived) object amodally if we receive no sensory stimulation from that part of

[2] Some may not accept the key assumption behind this question, namely, the assumption that we do represent the occluded parts of perceived objects. I address what I take to be the most plausible version of this worry in Sect. 5.

[3] See also Sorensen (forthcoming) on the auditory sense modality.

[4] I am grateful to an anonymous reviewer for drawing my attention to these interesting examples of amodal perception that do not involve occlusion.

the object. There may be various reasons why we do not receive any sensory stimulation from this part: it may be occluded, it may be not illuminated, etc.[5]

Finally, a quick note about the relevance of this question. It needs to be emphasized that amodal perception is not a weird but rare subcase of our everyday awareness of the world. Almost all episodes of perception include an amodal component. For example, typically, only three sides of a non-transparent cube are visible. The other three are not visible—we represent them 'amodally'. The same goes for houses or for any ordinary object. We perceive the back side of any (non-transparent) object only amodally. In fact, there are very few objects that we do *not* perceive amodally: soap bubbles and transparent glass cubes being possible examples. The only scenarios where we perceive, but do not perceive amodally are likely to be ones where all the objects in our visual field are fully transparent objects—something that does not happen to us very often. In every other scenario, perception necessarily implies amodal perception. Thus, it is not possible to fully understand perception itself without understanding amodal perception.

3 The perception-account

There are two straightforward answers to the question about the way in which we represent occluded parts of perceived objects. The first is that we do perceive the cat's tail (Gibson 1972) and the second is that we do not see it, but only infer that it is there: we have a non-perceptual belief about it.

I start with the perceptual view. As J. J. Gibson, the most important proponent of this account, says, "the perception of occlusion, it seems to me, entails the perception of *something* which is *occluded*" (Gibson 1972, p. 229). This account may sound slightly puzzling. The cat's tail, after all, does not project onto our retina. We receive no sensory stimulation from it. The necessary and sufficient conditions for perceiving an object have been notoriously difficult to pin down, but a relatively widely accepted necessary condition for perception is the presence of sensory stimulation.[6] If I receive no sensory stimulation from an object, then I can't perceive it.

One may wonder whether this claim is true across the board. More specifically, take the blind spot. When we are looking at objects with one eye (and keep our eye fixated), we do not receive any sensory stimulation from objects that are projected onto the part of the retina where the blind spot is. Does this mean that we do not see them? The short answer is that this question is a version of the more general

[5] There may also be a worry about occlusion in the case of back-lit objects, as Roy Sorensen argues that in these cases occlusion relations are reversed as the more distant object is the occluder (Sorensen 1999, and especially Sorensen 2007, pp. 52–54 on the concept of occlusion). The more general formulation of amodal perception above fits both reversed and ordinary cases of occlusion.

[6] There are some exceptions. Roy Sorensen, for example, would question this necessary condition (Sorensen 1999, 2007, forthcoming), but would accept something similar that suffices for our purposes. He writes: "To see an object, the object must be causally responsible for the visual information" (Sorensen 1999, p. 45). The cat's occluded tail is not causally responsible for any visual information, thus, we cannot represent it perceptually.

question about amodal perception I am trying to answer in this paper. When some parts of the object we see are projected onto the blind spot, we have no visual information about these parts. The reason why we have no visual information about them is not that they are occluded by another object, but that they project onto the blind spot. Representing those parts of a perceived object that are projected onto the blind spot is a version of amodal perception (see Pessoa et al. 1998; Dennett 1996).

Thus, it seems that amodal perception is not perception at all. But then what is it?

4 The belief-account

The second relatively straightforward view about amodal perception is that it is not at all perceptual. We see those bits of the cat that are visible—that are not occluded—and we infer, on the basis of perceiving the visible parts of the animal (as well as on the basis of our familiarity with cat tails) that the occluded parts have certain properties. In other words, we do not see the cat's tail at all, we just come to have a (non-perceptual) belief about it.

Various objections have been raised against this suggestion (see Noë 2004, pp. 62–64), most of which appeal to our intuitions that amodal perception 'feels' perceptual. A straightforward and less intuitive problem is the following. Animals and small children are capable of amodal perception: they represent occluded parts of perceived objects (see, for example, Nieder 2002). Yet, according to some, they do not have beliefs (Davidson 1980). This is only a problem if one endorses the view that animals (and small children) do not have beliefs and this has been a minority view. Thus, this objection has a rather limited scope.

I would like to raise two new objections to the belief account.

4.1 First objection to the belief-account

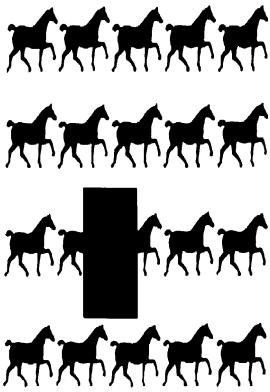
Amodal completion of occluded contours has been examined by psychologists for a long time. One of the most important findings from our perspective is that we use the simplest possible shape for completing the occluded part of a contour.

In Fig. 1, for instance, when we see the image in the middle, we tend to complete it in the way shown on the left and not the way shown on the right. More importantly, even if we have some firm beliefs about how we should complete the contour, we cannot help completing it in the simplest way possible (Fig. 2).

Because of all the other horse contours, we do know that we should complete the occluded part of the picture with the front half of the horse on the left and the back half of the horse on the right. Still, we cannot help seeing one extremely long horse.

Fig. 1 Amodal completion

Fig. 2 The horse illusion



If the belief-account of amodal completion were correct, then this would mean that we infer on the basis of our background beliefs as well as the visible parts of the horses that the occluded shape is such and such. Thus, we form a non-perceptual belief that the occluded shape is such and such. But, as we have seen, we come to represent the occluded shape to be a long horse, in spite of the fact that we have firm beliefs that it is supposed to be completed as two normal size horses. The way we complete this shape is insensitive to our other beliefs. But a belief cannot be insensitive to our other beliefs, at least not too often and not for too long.[7]

But the real problem is not this, as at least sometimes, at least for a short time, a belief can be insensitive to some of our other beliefs. The real problem is that my belief that is said to represent the occluded long horse is supposed to be inferred from my background beliefs about the shape of (short) horse contours. Even if a belief could at least sometimes be insensitive to some of our other beliefs, it certainly cannot be insensitive to those of our beliefs it is supposed to be inferred from.

Thus, the representation of the occluded shape is very unlikely to be a belief. It is important to note that this objection shows that there are some cases of amodal perception when the occluded parts of the perceived object are not represented by a belief. I have not shown that this is so in all cases of amodal perception. Thus, it follows from this argument that the belief-view cannot provide us with a general account of amodal perception. Now I hope to show that the belief-view can't even provide us with a partial explanation of amodal perception.

4.2 Second objection to the belief-account

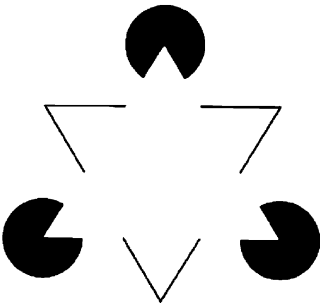
Take the following image, the Kanizsa triangle, which is considered to be the prime example of not amodal, but modal completion (Fig. 3).

Modal and amodal completion are different.[8] The standard way of drawing this distinction is the following. In the case of the amodal perception, we represent

[7] See Harman (1984) for a classical analysis of the topic of contradicting beliefs.

[8] See Singh (2004) for a good overview of the differences between modal and amodal completion.

Fig. 3 The Kanizsa triangle



objects behind an occluder,[9] whereas in the case of modal completion, we represent an object in front of inducers, such as the three circles in the figure.[10]

There are, however, very important similarities. In the case of both modal and amodal completion we represent shapes or objects we have no sensory information about. In both cases, we experience contours that are not present in the figure we are looking at. It has been argued that the neural mechanisms responsible for modal and amodal perception are the same in early vision and they only come apart at a very late stage of visual processing (Kellman and Shipley 1991; Ramachandran 1995; see also Driver et al. 2001). As a result, many early vision researchers as well as philosophers do not even make this distinction (Grossberg and Mignolla 1985; Noë 2002, 2004, 2005). Thus, we have good reason to assume that the early neural mechanisms responsible for our representation of the nonexisting sides of the Kanizsa triangle and of the occluded contour of the horse above are the same. Thus, the empirical study of the way we represent the sides of the Kanizsa triangle may give us some important results about amodal perception.

The perception of Kanizsa triangle has been thoroughly examined experimentally. The two most important results for our purposes are the following. First, it turns out that there is no activation of the cells in the retina that would correspond to the sides of the triangle, which is in itself an important consideration against the perception-view. Second, and more importantly, we do find activation patterns in the primary visual cortex, the earliest stage of visual processing, that corresponds to the sides of the triangle (Lee and Nguyen 2001; see also Komatsu 2006).

The belief-view would predict that there is no cell-activation that would correspond to the invisible shapes of the figure in the early stages of visual processing. If these shapes are represented by a belief, then the primary visual cortex is not supposed to represent them. We have to be careful with this claim though. A possibility that needs to be considered is that the belief activates the primary visual cortex in a top-down manner: first, the invisible are represented by a belief and then this belief activates the corresponding regions of the primary visual cortex. It has been a controversial issue whether the primary visual cortex can be influenced in a top-down manner, and if so, in what way (see Karmiloff-Smith 1992;

[9] But see my reservations about this way of defining amodal perception in Sect. 2.

[10] See, for example, Tse (1999, pp. 37–38). The terms originally come from Michotte et al (1964).

Pylyshyn 1999; Li et al. 2004). But even those who argue for the strongest top-down influence point out that while the response properties of the neurons in the primary visual cortex can be modified in a top-down manner, token activation cannot be a result of top-down influence (Karni and Sagi 1991; Li et al. 2004). To sum up, it follows from the belief view that there is no activation in the primary visual cortex that would correspond to the invisible shapes.

But, as it turns out, there is significant cell-activation in the primary visual cortex when we are looking at the Kanizsa triangle. Moreover, the pattern of the cell-activation in the primary visual cortex corresponds exactly to the sides of the triangle and, as we have seen, this cannot be a result of any top-down influence. The belief-view has an immediate consequence that contradicts important empirical findings. Thus, the belief-view is unlikely to be the right way of explaining the representation of occluded shapes.

A possible objection needs to be addressed at this point, as one may object to the use of these empirical results for settling a philosophical question about perception. More precisely, one may ask why this is relevant at all. After all, it is possible to imagine a creature that can perceive amodally while its neural activation patterns are very different from ours: there is no activation in its primary visual cortex. My response is that my argument is supposed to be about human (and maybe other non-human animal) perceivers. But the question I am concerned with here is not about some metaphysically possible perceivers, but perceivers like us.

5 The access-account

It has been suggested recently that what makes us aware of the cat's tail is that we have perceptual access to it. I do not see the cat's tail now, but if I moved my head, I would see it. Thus, I have immediate perceptual access to the very fine-grained properties of this object right now—even if it is occluded from me at the moment (Noë 2002, 2004, 2005, the account has its roots in Pessoa et al. 1998).

This suggestion is an interesting alternative to the perceptual- and the belief-view, but it is important to notice that it is significantly different from the previous two proposals. The access-account is primarily concerned with the question of perceptual presence and not of representation. It tries to explain how it is possible that the cat's tail is perceptually present to us. It does not try to answer the question about the way in which the cat's tail is represented.

The access-account can say two things about the question of representation. First, it can remain neutral, in which case the access-view would be consistent with any account of the way we represent the cat's tail (it would also be consistent with the perception-view, the belief-view, as well as the account I will argue for in what follows). I have nothing to say about this version of the access view as it is orthogonal to the question I am trying to answer.

Second, and this is why the access-account needs to be addressed in this context, one could argue that the answer the access-account should give to the question about the representation of occluded parts of perceived objects is a very radical one: we do not represent the cat's tail at all. It is *perceptually present* to us, because we have

immediate perceptual access to it, but we do not *represent* it at all (Noë 2004, esp. pp. 21–23; see also 2005).

I will argue against this second, more radical, version of the access account and point out that it fails to provide a coherent account of amodal perception, for the following three reasons.

5.1 The first objection against the access-account

It is important to emphasize that amodal perception relies heavily on our background knowledge of how the occluded parts of the object (may) look. If I have never seen a cat, I will have difficulties attributing properties to its tail behind the fence. If I am familiar with cats, however, then this would not be a problem. The 'perceptual presence' of the cat's tail will be very different if we know how cat tails look and if we don't. And here we encounter a problem for the access account. According to the access account, what matters is my immediate perceptual access to the occluded object, and this access does not depend on whether I know how cat tails look. Thus, it follows from this view that I would have the same perceptual access to the cat's tail whether or not I know how cat tails look. Thus, the access account cannot allow for the difference between our awareness of the cat's tail in these two cases. It would follow from the access-account that our background knowledge is not relevant in amodal perception. But this is not (or at least not always) the case.

We need to be careful with the scope of this argument. We have seen in the last section that there are cases where our amodal perception is insensitive to our beliefs. But, as the cat behind the fence example shows, there are cases where it isn't. Thus, the fact that amodal perception relies on our background knowledge counts against the proposal that the access-account could explain all cases of amodal perception. Thus, so far I have shown that the access-view cannot provide a general account of amodal perception. But I have not shown that it is not possible that some (but not all) cases of amodal perception are explained by the access-view. This is what I will attempt to do in the rest of this section.

5.2 The second objection against the access-account

Suppose that the cat has just disappeared behind the door. Is it perceptually present to me? I do have some kind of access to the cat's tail in the next room: I could walk over and have a look. Thus, it seems that it follows from the access-view that the cat's tail in the next room is perceptually present to me. But this sounds wrong.

The proponents of the access-view have conflicting strategies to address this problem. On the one hand, they seem to acknowledge that the difference between our awareness of the cat's tail behind the fence and in the next room is a gradual one and they even explicitly state that this gradual transition is an important feature of perceptual presence (Noë 2002, p. 11, footnote 14; 2004, p. 65). On the other hand, they argue that there is a clear-cut distinction between the two ways of being aware of the cat's tail (Noë 2004, pp. 64–65). As these two strategies are present often in the same chapter, one worry is that there seems to be a contradiction in the account.

A more significant worry is that neither of these two conflicting strategies yield acceptable results. Take the former suggestion: the difference between our awareness of the cat's tail behind the fence and in the next room is a gradual one. If this is true, then the access view has a fairly implausible consequence: I do not perceive the cat in the next room, so how can it be *perceptually* present (even a little bit perceptually present) to me? If the cat's tail in the next room is perceptually present to me, what would stop the proponents of the access-view from saying that the same is true if the cat is in a house across the street or in a different city or country?

Take the latter suggestion: there is a clear-cut distinction between the two ways of being aware of the cat's tail. It is not clear what is supposed to constitute the difference between our access to the cat's tail behind the fence and in the next room. The advocates of the access account tried to clarify the distinction between these two cases in several different ways. As Alva Noë points out in his latest attempt to do so, the big difference between our access to the cat's tail behind the picket fence and in the next room is the following. Our sensory stimulation varies as *we* move around in both cases (but in different degrees: I would move my head more in the second case). But there is a difference between the two scenarios in the way our sensory stimulation varies as the *object* moves. If the cat behind the picket fence wags its tail, this brings about a change in my sensory stimulation. If it does so in the next room, it does not (Noë 2004, pp. 64–65).

The problem with this suggestion is that if the cat moves its tail only slightly behind the fence in such a way that the tip of the tail does not become visible, this will not bring about any change in my sensory stimulation. Thus, according to the distinction, the slightly moving tail is present to me in the same way as the cat's tail in the next room is present to me: neither of them are *perceptually* present. But this undercuts the original claim that occluded parts of perceived objects are perceptually present to us.

5.3 The third objection against the access-account

The third objection is much simpler than the previous two. Some of the most famous examples of amodal perception are examples of two dimensional figures, like Figs. 1 and 2. The proponents of the access account often use these examples of amodal perception when outlining their view (see Pessoa et al. 1998, pp. 729–730; Noë 2002, p. 9, 2004, pp. 61, 70).

But it is unclear what the access account would say in the case of amodal completion of the occluded parts of two dimensional figures, since there is no head- or eye-movement that would give us perceptual access, let alone immediate perceptual access, to the momentarily invisible part of the curve in Fig. 1. Thus, we do not have any perceptual access to the occluded part of the circle. Still, we perceive it amodally.

The advocate of the access account could block this argument by saying that we do have expectations about how the occluded shape would look were we to look behind the occluding surface. Even if it is impossible to look behind the occluding surface, I do have expectations about what I would see if I were to look behind. This

move, however, would make the notion of 'immediate perceptual access' vacuous, as we could also have expectations about how a cat in the next room (or thousands of miles away in another country) would look if we were to look, but the access account, rightly, wants to deny that we have immediate perceptual access to these objects.[11]

6 The imagery-account

My suggestion is that we represent the cat's tail by means of mental imagery. But what do I mean by mental imagery? Here is a relatively general characterization:

> Mental imagery refers to all those quasi-sensory or quasi-perceptual experiences of which we are […] consciously aware, and which exist for us in the absence of those stimulus conditions that are known to produce their genuine sensory or perceptual counterparts, and which may be expected to have different consequences from their sensory or perceptual counterparts. (Richardson 1969, pp. 2–3)

It is easier to explain mental imagery in the visual sense modality, which is the one we are focusing on in this context. A paradigmatic case of visual imagery would be closing one's eyes and imagining seeing an apple 'in the mind's eye' (see Kosslyn 1980; see also Ryle 1949, Chap. 8.6; Currie and Ravenscroft 2002). Having some kind of mental imagery of an apple should be differentiated from imagining that there is an apple in the kitchen, an imagining episode often labeled as propositional imagining. The latter is a propositional attitude, whereas the former is a quasi-perceptual process (see Nanay forthcoming).

Further, it is important to point out that visual imagery does not necessarily imply visualization. We usually think of visualization as an active, intended act: 'to visualize' may even be a success-verb. Having some kind of mental imagery, on the other hand, can be passive and it is not necessarily intended.

The equivalent of visual imagery in other sense modalities would be auditory or tactile or olfactory imagery. I will use the term 'mental imagery' to refer to all of these.

Thus, my proposal is that when we represent the cat's occluded tail, we do so by having visual imagery of the tail.[12] I will defend this proposal in the rest of the paper.

[11] Further, if we have expectations about the cat's tail behind the picket fence, this means that we need to represent it in some ways. But then our original question reoccurs again: how do these expectations represent the cat's tail? In perception? With the help of beliefs? The problem of amodal perception remains unsolved.

[12] Berkeley could be interpreted as holding a version of this view. He writes: "the immediate perception of ideas by one sense suggests to the mind others, perhaps belonging to another sense, which are wont to be connected with them" (Berkeley 1713/1979, p. 39). The examples he gives for this 'perception by suggestion' are all examples where the two sense modalities are different, but his phrasing permits that they would be the same. And 'perception by suggestion' seems to represent its object by mental imagery: the represented objects "[…] are not the objects of sight, but suggested to the imagination by […] color and figure" (ibid., pp. 39–40).

Usually, when we have mental imagery of a chair, say, when we close our eyes and visualize a chair, we cannot localize this chair in our egocentric space. But this is not a necessary feature of mental imagery. Sometimes the object we imagine is indeed localizable in our egocentric space. As M. F. G. Martin writes:

> [I]n imagining something as to the left one does not thereby imagine as in one's actual environment on the left. Of course one can project one's imagery in this way, and take things which one visualizes as imagined to be within one's actual environment; but this is not necessary, nor is it the simplest case of visualizing. (Martin 2002, p. 410)

When we represent the occluded parts of perceived objects, we use mental imagery in this latter sense: in a way that would allow us to localize the imagined object in our egocentric space. When I represent the cat's occluded tail, I represent it as having a specific spatial location in my egocentric space.

To see the empirical plausibility of this proposal, it is worth going back to the findings about the perception of the Kanizsa triangle. As we have seen, the early neural mechanisms responsible for our representation of the nonexisting sides of the Kanizsa triangle and of the occluded tail of the cat are the same. Thus, the empirical study of our representation of the sides of the Kanizsa triangle may give us some important results about amodal perception.

We have also seen that although there is no activation of the cells in the retina that would correspond to the sides of the triangle, we do find such corresponding activation patterns in the primary visual cortex, which is the earliest stage of visual processing (Lee and Nguyen 2001; see also Komatsu 2006). Incidentally, this is also where cells are activated when we visualize objects with our eyes closed (see e.g., Kosslyn et al. 1995). I take these results to be indicative that I am on the right track, but I will not argue that this confirms my suggestion.

It may be worth examining whether some of the objections I raised against the alternative views could be applied in the case of the imagery account.

I pointed out earlier that amodal perception relies heavily on our background knowledge of how the occluded parts of the object (may) look. This feature of amodal perception was one of the major objections to the access-view. If I have never seen a cat, I will have difficulties representing its occluded tail behind the fence. The same is true for mental imagery. In order to have mental imagery of a chair, I need to know how chairs look. This is yet another indication of the similarity between amodal perception and mental imagery.[13]

Further, my proposal does not face the second problem I raised in the case of the access-view. I can have mental imagery, even fairly precise mental imagery, of a cat in the next room or even thousands of miles away from here, if I visualize it. I can even visualize the tail of a cat that does not exist. If my proposal is correct, then the way I represent the cat's tail in the next room and the way I represent the occluded

[13] It is important to point out that this dependence of amodal perception on background knowledge will not itself settle the question about how we represent occluded parts of perceived objects. A number of our representational abilities (perception, belief, mental imagery) can depend on our background knowledge, after all.

tail of the cat I am looking at are of the same kind: both of them are represented by means of mental imagery.

But the perceptual presence in these two cases is likely to be very different. If I visualize a cat, there tends to be no perceptual presence. If I perceive it amodally, there is. Thus, the conflicting strategies of the access-view with regards to the difference between our awareness of the cat's tail in the next room and behind the fence may be due to the confusion of the question of representation and the question of presence. Our way of representing the two are very similar, but the way they are present to us are different.

7 The role of attention: imagery and visualization

One possible worry about my suggestion is that it implies that we visualize objects all the time, since we perceive partially occluded objects all the time. However, this sounds intuitively implausible. When I'm walking down the street, looking at one house occluding another one, it does not appear to me as if I visualized anything.

In response to this objection, it needs to be pointed out that my claim was not that we visualize the cat's occluded tail but that we represent it by means of mental imagery. And, as we have seen, having mental imagery does not imply visualization. Visualization takes effort. It is an active, intended act. Having mental imagery, on the other hand, can be passive and it is not necessarily intended.

This objection is a relevant one because it highlights the importance of attention in amodal perception. Sometimes we do actively visualize occluded parts of perceived objects. In this case we attend to these features. Some other times, we don't do this.

In order to address this distinction, it needs to be pointed out that attention plays a very important role in our everyday perception, thus, we should not be surprised if it played an equally important role in amodal perception. The inattentional blindness experiments demonstrated that we can be shockingly blind to those features of our surroundings that we are not paying attention to Mack and Rock (1998). Probably the most famous inattentional blindness experiment is the following (Simmons and Chabris 1999). We are shown a short video-clip of two teams of three, dressed in white and black, passing a ball around. We are asked to count how many times the white team passes the ball around. On first viewing, most of the observers come up with an answer to this not very interesting question. On second viewing, however, when there is no counting task to be completed, they notice that a man dressed in gorilla costume walks right in the middle of the passing game, makes funny gestures and then leaves. The gorilla spends nine seconds in the frame and most viewers do not notice it when attending to the passing of the ball.

Given the similarities between perception and imagery (see Kosslyn 1980; Laeng and Teodorescu 2002; O'Craven and Kanwisher 2000), it is hardly surprising that the same is true for the way we visualize objects. If I have mental imagery of the house I grew up in as seen from the front, I am unlikely to be aware of whether there is light in the left window on the first floor as I am not attending to this specific feature. But I can visualize this specific feature, if I attend to it.

And the same is true of our mental imagery of partially occluded objects. Most of the time, the shape, size or color of occluded object-parts go unnoticed, because we pay no attention to them. If, however, we do attend to them—if, for example, we wonder, what color an occluded part of a building is—then we can visualize them. Attention plays a very similar role in amodal perception as it does in perception *per se*.[14]

8 Corollary: perceptual presence

I said in Sect. 2 that I will not address the question of perceptual presence. But it is worth noting that if we accept my proposal for explaining how we represent occluded parts of perceived objects, we get a simple answer to the question of perceptual presence. Again, the question of perceptual presence was this: how can we explain that what it is like to be aware of the occluded parts of perceived objects is similar to what it is like to perceive those parts that are not occluded?

If we represent the occluded parts of perceived objects by means of mental imagery, then we have a straightforward explanation. What it is like to have mental imagery of a chair is similar to what it is like to see a chair. Mental imagery is in many respects, and especially as far as its phenomenal character is concerned, similar to perception. In the so-called Perky experiments (Perky 1910) the agents, who were asked to visualize objects with their eyes open and staring at a white wall, did not notice when hardly visible images of the visualized objects were projected on this wall. They thought that these perceived images were in fact their visual imagery. This experiment (see also Segal 1972; Segal and Nathan 1964) is taken to suggest that the phenomenal character of perception and that of visualization are very similar—if two phenomenal experiences are indistinguishable, they must be quite similar.

But if what it is like to have visual imagery is similar to what it is like to perceive and being aware of occluded parts of perceived objects is having visual imagery, then, putting these two claims together, we get that what it is like to be aware of the occluded parts of perceived objects is similar to what it is like to perceive those parts that are not occluded. Thus, my proposal that we represent the occluded parts of perceived objects by means of mental imagery has the additional advantage that it gives a simple answer to the question of perceptual presence.

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[14] A related objection is the following. Perception is determinate: when we perceive a polygon, it has a definite number of sides, even if the viewer does not know the number. But mental imagery is indeterminate. So if imagery completes the polygon amodally, there will not be a definite number of sides it supplied. My response is that perception is not determinate. The object causing the perception is determinate: the perceived polygon has a definite number of sides. But the content of my perceptual experience may not be (and normally is not) determinate. Our peripheral vision, for example, is very indeterminate indeed. And the same is true of mental imagery. Amodal perception (conceived as mental imagery) does not bring in a greater degree of indeterminacy than extra-foveal perception. (I am grateful to an anonymous reviewer for raising the question of determinacy about my account.)

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