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Seeing and visual reference

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Abstract

Perception is a central means by which we come to represent and be aware of particulars in the world. I argue that an adequate account of perception must distinguish between what one *perceives* and what one's perceptual experience is *of* or *about*. Through capacities for visual completion, one can be visually aware of particular parts of a scene that one nevertheless does not see. Seeing corresponds to a basic, but not exhaustive, way in which one can be visually aware of an item. I discuss how the relation between seeing and visual awareness should be explicated within a representational account of the mind. Visual awareness of an item involves a primitive kind of reference: one is visually aware of an item when one's visual perceptual state succeeds in referring to that particular item and functions to represent it accurately. Seeing, by contrast, requires more than successful visual reference. Seeing depends additionally on meta-semantic facts about how visual reference happens to be fixed. The notions of seeing and of visual reference are both indispensable to an account of perception, but they are to be characterized at different levels of representational explanation.

Perception is a central means by which we become aware of the surrounding world. In virtue of my current visual state or experience, I am aware of the size, shape, and color of the desk in front of me. Moreover, one does not simply experience a matrix of properties—sizes, shapes, colors, and whatever else—which the particular objects of the world may or may not possess.

What is variously called the *particularity*, *singularity*, or *de re* nature of perception consists in the fact that one's perceptual state or experience can be of particular items in a scene, such that it is those specific items and no others that one experiences as having certain sizes, shapes, and so on. My current visual experience is not simply of *something or other* but is rather of *this very object*. Accordingly, how closely my experience matches the world or not—its degree of accuracy—depends on how closely it matches this particular object. Let us say that one is *perceptually aware of* an item if that item in fact exists and one's perceptual state or experience is of, or about, that item in particular. The capacity to be aware of particulars in the world is a vital cognitive achievement, allowing one to represent an entity as that entity and not just as whatsoever satisfies a description.

It is widely recognized that accounts of the particularity of perception must accommodate the following facts. First, an item can perceptually appear to have features that it does not have, as in standard visual size, shape, and color illusions. Second, one can seem to experience an item when in fact no such item exists, as in certain hallucinations. In this paper, I argue that such accounts must accommodate a further, less appreciated fact: one can be visually aware of particular parts of a scene without seeing those parts. Theories of perception must therefore distinguish between *seeing* a particular and *being visually aware* of it—more broadly, between *perceiving* a particular and *being perceptually aware* of it. After motivating this distinction, I will suggest that seeing and visual awareness figure into distinct levels of explanation of our abilities to obtain perceptual access to particulars in the world.

The phenomenon of perceptual completion provides the wedge that drives apart what one sees from what one is visually aware of. The patterns of light that reach the eyes from any given thing are almost always fragmented. Mountain ridges, telephone lines, and cars are partly occluded by nearby trees, lampposts, and buildings. Yet one's experience is not of a radically, arbitrarily fragmented world. Humans and other animals have a suite of capacities for visual completion that are employed for most things in most scenes and that are foundational to our capacities to perceive whole, integrated objects, rather than a mere mosaic of disconnected fragments (see Kellman, 2003; van Lier & Gerbino, 2015). These capacities allow one to visually experience, in addition to the visible fragments of things, the unified wholes to which different fragments belong. In fact, humans and many other animals are surprisingly accurate and precise not only in which visible fragments we perceive as parts of the same object, but also in how we perceive those fragments to be connected behind the occluding surfaces. More often than not, one is accurate when one experiences a mountain ridge in the distance as continuing smoothly behind the lamppost in the foreground, rather than peaking sharply or giving way to a valley that is exactly covered up by the lamppost. In fact, I will suggest that in experiencing the mountain ridge as continuing smoothly behind the lamppost, one can be visually aware not only of the whole mountain ridge and its global shape, but also of the particular occluded fragments of the ridge and the local properties of those fragments. One can be visually aware of occluded fragments, though one cannot see them.

Many deny that one can have genuine visual experiences of the occluded parts of things (see, for example, Bermúdez, 2000). Others grant that one's visual experience can be of these hidden parts and draw the conclusion that one can *see* what is not visible (see, for example, Ganson, 2020; Munton, 2021). I will take the middle way. One's visual experience can be of the very part of the mountain ridge that is occluded; yet there is a significant sense in which one cannot see that part of the ridge. While terms such as "sees," "experiences," and "is aware of" all have a multiplicity of usages, the distinction that emerges here between *seeing* an item and being *visually aware of* it has real explanatory import. An adequate account of how we have perceptual access to particulars in the world should distinguish these notions, while explicating how they are related. I focus here on vision, though analogous capacities for completion exist in hearing and touch. While I will focus here on perceptual states that can be consciously experienced, I do not assume that either one's seeing a particular or one's being visually aware of it, as I intend to use these expressions, must be conscious.

The distinction between visual awareness and seeing has significant consequences for theories of perception. For example, a core task for representational theories of the particularity of perception is to explicate *seeing* and *perceiving* in terms of semantic notions such as accuracy and reference. The account I will develop of the relation between seeing an item and being visually aware of it builds on existing attempts to do this, although I will cast the notion of seeing in a different explanatory role than these prior accounts. According to the accounts on which I draw, the particularity of perception consists in the fact that perceptual states have (or function to have) singular, *de re* accuracy conditions. Roughly: a full specification of the accuracy conditions of a token perceptual experience must contain a place for indicating the particular items on which the accuracy of that experience depends (see, for example, Burge, 2005, 2010). The contents of perceptual experiences—the ways these experiences characterize the world—involve a primitive form of *reference*. Given the context in which my experience is formed, that experience itself refers to *this* object and attributes a certain shape to it. Notice that on this account, referential content is not confined to the judgments that I form on the basis of a perceptual state or experience; the perceptual state or experience itself bears referential content.

Such an account of the contents of perception is well-suited to explicating what it is for a perceptual experience to be of or about particular items (cf. Soteriou, 2000; Martin, 2002). One's experience is of a particular—one is perceptually aware of that particular—just in case one's experience succeeds in referring to that particular in a given context and thereby functions to represent the particular accurately. However, if some aspect of one's visual experience can successfully refer to a part of the scene that one does not see, then successful visual reference must not be sufficient for seeing. I will suggest that whereas to be visually aware of an item depends on successfully visually referring to that item, whether one sees an item depends in addition on the specific *meta-semantic* grounds by which visual reference to the item is fixed. Seeing marks one way in which the ability to visually refer can succeed. However, this specific way of fixing visual reference is not encoded in the contents of perception. Seeing does not involve a special mode of visual reference.

In Sections 1–3, I motivate the distinction between being visually aware of an item and seeing it. In Section 1, I argue that one can visually experience the shape, location, and other features of occluded elements in a scene. In Section 2, I argue that in experiencing the features of an occluded element, one can be visually aware of the particular element itself, *de re*. When visual completion of the mountain ridge is successful, one is not just aware of the ridge having *some* occluded part, one is aware of *that particular occluded part* of the scene. In Section 3, I argue that there is an explanatorily significant distinction between seeing an item, which one cannot do when the item is occluded, and being visually aware of it. What one is visually aware of depends asymmetrically on what one sees. In Section 4, I explore the implications for understanding seeing and visual awareness in terms of abilities to represent the world. Both notions are indispensable to understanding how we perceptually represent particulars, but they belong to different levels of representational explanation.[1]

[1] Though my account of the relation between seeing and visual awareness is couched in a representational approach to perception, the argument for a distinction between these notions does not depend essentially on such an approach. Any account of perception should therefore accommodate this distinction. For example, relationalist views hold, roughly, that perception is a relation constituted by a perceiver together with particular items in a scene (for example Campbell, 2002; Martin, 2006; Brewer, 2011; Logue, 2012). Experiences that count as genuine perceptions (as opposed to hallucinations) have mind-independent objects as constituents. Relationalist views must explain the connection between the relation that constitutes seeing (or perceiving) and the relation that constitutes visual (or perceptual) awareness.

1 | MINDING THE GAPS

Over the next three sections, I defend the following argument for distinguishing between seeing an item and being visually aware, or having a visual experience, of that item:

(1) One can visually represent and experience occluded features in a scene, such as the local shape of an occluded part of an object's outline.
(2) In representing and experiencing occluded features, one can be visually aware (*de re*) of the particular occluded parts of the scene to which those features belong.
(3) One cannot see parts of a scene that are occluded.
(4) Therefore, one can be visually aware (*de re*) of particular elements that one does not see.

Many deny the first premise in one form or other. For example, Bermúdez asserts that "the parts of an object which are hidden on a given occasion make no contribution to the look of the object on that occasion" (Bermúdez, 2000, p. 363), where the "the look of an object is what allows the perceiver visually to discriminate that object from its surroundings" (Bermúdez, 2000, p. 364). Against this I will argue, first, that at least at the sub-individual level, the visual system differentiates and forms representations specifically about the features of hidden parts of the scene. These representations partly determine how one discriminates whole objects. I will then argue that the visual processing of occluded features corresponds to distinctive aspects of conscious experience. There is something it is like to experience the size, shape, location, and so on of specific occluded parts of a scene, and this constitutes part of what it is like to experience whole objects in the scene. I will conclude by responding to potential objections that the experience of occluded features is in some way non-perceptual.

My argument relies on our capacities for visual completion. Visual completion, broadly construed, comprises three conceptually distinct types of capacity: capacities to psychologically represent and consciously experience the connectedness or unity of visible fragments of a scene when those fragments do not project a continuous pattern of light to the eye (call this *unitization*); capacities to represent and experience the local positions, shapes, colors, textures, and so on of non-visible parts of an entity (call this *interpolation* or *filling-in*); and capacities to represent and experience the complete, global shape, color, texture, and so on of a whole, partly occluded object (*completion proper*). My argument appeals specifically to the *interpolation* of parts of a scene.

I focus in particular on the perceptual capacity to interpolate the occluded portions of the facing surface or boundary of an object ("amodal interpolation"), such as the bend in the black wire depicted in Figure 1a. There are close parallels between this capacity and the capacity to interpolate the features of partially camouflaged objects ("modal interpolation"), such as the well-known Kanizsa triangle or the curved figure in Fig. 7a below. It is widely, though not uncontroversially, thought that common mechanisms underlie these capacities (Kellman et al., 1998). While I believe that the argument in this paper can be run with cases of modal interpolation, such an argument would incur somewhat different burdens than the present argument based on amodal interpolation. For example, while the interpolation of camouflaged parts has a much more striking phenomenology than the interpolation of occluded parts, there is also a stronger tendency in the philosophical and empirical literatures to characterize modal interpolation as always "illusory."[2]

[2] I leave it open what other cases illustrate the distinction between seeing and visual awareness, although it is worth briefly mentioning two cases that are often associated with perceptual completion. First, when one sees an object gradually disappear behind an occluder and re-appear on the other side, one tends to experience a single, continuously moving

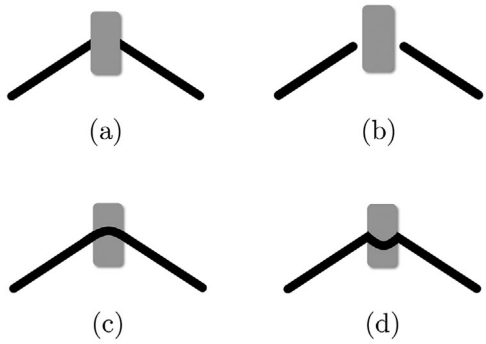


FIGURE 1 One's visual experience and psychological processes respond to the partly occluded wire depicted in (a) more like the way they respond to the wire in (c) than those in (b) and (d)

1.1 | Visual processing

When you look at the picture in Fig. 1a, you are likely to experience the black lines as connecting underneath the gray rectangle, where they form a bend approximately like the one you see in Fig. 1c. The effect would be especially pronounced if the visible black lines were moving up and down in common motion (Kellman & Spelke, 1983) or if there were additional depth cues indicating that the black lines are farther back than the gray surface (Nakayama et al., 1995). Of course, the black lines are in fact disconnected paths of ink (or pixels) on a two-dimensional surface. But suppose you were looking at a real-world scene that appears similar to Fig. 1a, containing a black wire, the curved part of which is covered up by a notecard. In this scenario, you experience the wire as continuing behind the occluder and as bending in a certain way. Suppose things are just as you experience them: the wire *does* continue behind the occluder and *does* bend in just the way you experience it as bending. Suppose, moreover, that prior to this encounter you have never seen the occluded section of wire or any other part of the wire for that matter.[3] The crucial claim now is that visual processes can differentiate and accurately represent the local features of specific bits of occluded wire, such as the curvature of the hidden kink in the wire.

We should be careful not to move too quickly from the fact that the visual system represents features of the whole bent wire to the claim that the visual system represents features of occluded parts of the wire. Unitization and global completion do not logically entail interpolation (see Pessoa et al., 1998). It could be that one's visual system represents the global shape of the whole wire

object. This is sometimes called the "tunnel effect." Munton (2021) argues that in such cases, one has a genuine visual experience of an object at the moment that it has fully disappeared behind the occluder. She concludes that we *see* the object even when it is fully occluded. I will argue in Section 3 that there must be a strict sense in which one cannot see the occluded object. If Munton is right that one has a genuine visual experience of the object when it is occluded, and if I am right that one nevertheless does not *see* the object in a strict sense, then the tunnel effect would provide an additional case for my argument in this paper.Second, it is sometimes suggested that the experience of objects as having three-dimensional volumetric shape (seeing something as cubical, for example) is a form of perceptual completion that involves the interpolation of the object's self-occluded backside (van Lier, 1999; Nanay, 2018). However, there has not been enough experimental work to conclude, for example, that perceptually representing something as having a cubical shape normally involves explicitly representing the back surface of the object as square. The strongest evidence that we perceptually represent occluded parts of objects concerns the interpolation of facing surfaces and boundaries.

[3] I will adopt this sort of pretense anytime I refer to how one experiences a diagram. I do not intend to describe experiences of the diagrams themselves, but rather hypothetical experiences of scenes depicted by those diagrams.

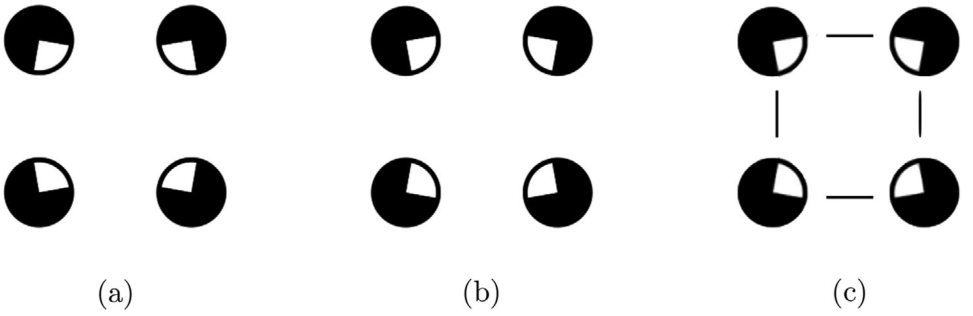


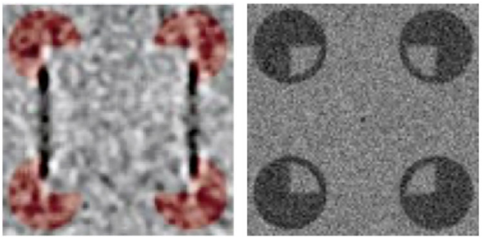
FIGURE 2 Stimuli like those used in Ringach and Shapley (1996): (a) a "thick" figure; (b) a "thin" figure; (c) an interference condition

as BENT, without specifically representing the occluded part itself as CURVED.[4] Maybe local features of the occluded part of the wire are only *implied* in the visual system's representation of the whole wire's global shape. Against this possibility, I will cite behavioral, neurophysiological, and computational considerations suggesting that local features of occluded parts are explicitly represented in visual processing and play an important role in how the visual system represents global properties of whole objects. In the next subsection, I will suggest that the visual processing of these features can have correlates in conscious visual experience.

Let us start with behavioral studies of masking. Think of the black circles in Fig. 2 as portholes through which you can see the corners of a partially hidden white figure. You should experience a "thick" figure with left and right sides bowing outwards in Fig. 2a and a "thin" figure with sides bowing inwards in Fig. 2b. In a classic study investigating the role of interpolation in the perception of partially occluded shapes, Ringach and Shapley (1996) tasked subjects with discriminating whether the partially occluded figure in such a stimulus was "thick" or "thin." To determine what role, if any, representations of occluded segments of the figures played in discriminating the shapes of these figures, Ringach and Shapley superimposed over the stimuli straight line segments that overlapped the presumptively occluded sides of the figures, as illustrated in Fig. 2c. They found that the added line segments "masked" or interfered with the discrimination of the underlying figure's shape. In short, subjects were slower, less accurate, and less precise in their shape discriminations, even though the added lines did not actually distort any light coming from the underlying shapes. A standard interpretation of this result is that the discrimination of the global shape of the whole figure, as THICK or THIN, requires representing the occluded boundary segments of the figure. The visual system does not simply jump from processing the visible corners of the partially occluded figures to representing the whole figure's global shape. Rather, representing the global shape involves forming representations of the component segments of the figure's boundary—some of which are occluded. The masking effect arises because processing representations of the visible straight lines interferes with processing representations of the occluded curved boundary segments underneath, and thereby interferes with processing representations of the whole shape.

Here is the logic supporting this interpretation. A common pattern in perception is that if features of a stimulus receive similar kinds of perceptual representations, then the processing of one such feature will likely mask or interfere with the processing of another—like competes

[4] I use expressions in small caps as a rough and ready way to denote contents represented in visual processing.



(a) (b)

FIGURE 3 (a) Example of a "classification image" (adapted from Gold et al., 2000, p. 664, with permission from Elsevier). The dark lines indicate locations in which pixel noise significantly correlates with the subject's discrimination of the underlying figure in a stimulus like that in (b) (this stimulus example was provided by Richard Murray). (Pixel noise corresponding to the occluded top and bottom sides of the figure apparently did not influence discrimination. This may be because the response categories of "thick"/"thin" biased subjects to base their responses on the vertical sides.)

with like. For example, it is more difficult for the visual system to process a representation of a line segment's orientation when the system is also processing representations of other line segments with similar orientations at similar locations. By contrast, the processing of an item's orientation tends not to interfere with the processing of dissimilar orientations at dissimilar locations or with the processing of other perceptual dimensions such as color. Working backwards, if one stimulus feature is discovered to mask another, this is evidence that these features receive similar kinds of representations in the visual system. By investigating these patterns of interference and non-interference, we can develop a precise picture of how the visual system codes features like orientation, color, location, and shape. Turning back to Ringach and Shapley's results, they found that straight lines interfered with the discrimination of whole shapes. To explain this interference, we must identify some represented feature of the stimulus that is comparable to, and so competes with, the representations of the straight line segments. It is much more plausible that the representation of a one-dimensional line segment as STRAIGHT competes with a representation of a one-dimensional line segment as CURVED than that it competes with a global representation of a closed two-dimensional shape as THIN. The natural explanation for why the processing of straight lines interferes with the discrimination of the whole shape, then, is that representing a shape as THIN or THICK involves representing occluded segments of the shape's boundary as CURVED in the appropriate ways, and that representations of visible line segments as STRAIGHT interfere with representations of nearby occluded boundary segments as CURVED.

One concern with this study is that the visual system might treat the masking line segments as forming a separate, global square pattern or "gestalt." If that were the case, then the cost to performance on the shape discrimination task might be due to competition between representations of different global shapes—THIN versus SQUARE, say—rather than competition between representations of different boundary segments as CURVED versus STRAIGHT. Another concern might be that the perceived orientations of the straight line segments interfere with the perceived orientations of the visible corner segments.

To address concerns of this sort, Gold et al. (2000) presented thick and thin figures covered in static white noise, as depicted in Fig. 3b. The masking features in this case—random fluctuations in pixel luminance—did not give rise to a global shape percept that would compete with the perception of the partially occluded figure or affect the perceived orientations of the corners. Gold

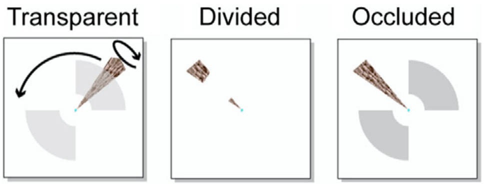


FIGURE 4 Neuroimaging reveals common traces of neural responses when the wedge sweeps past the occluders in the transparent and occluded conditions but not in the divided conditions. Adapted from Ban et al. (2013) (CC-BY-NC-SA 4.0)

et al. correlated subjects' performance on the shape discrimination task with the variations in pixel noise across trials. Fig. 3a illustrates a "classification image," in which the contrast between the luminance of a pixel and the background indicates the strength and direction of the effect that variations in luminance at that location had on shape discrimination. The error induced by pixel noise was not distributed randomly across the image, but significantly corresponded to the presumptively occluded parts of the figure. Consistent with the logic behind the interpretation of Ringach and Shapley's results, Gold et al.'s results suggest that the registration of pixel noise interferes with representations of fragments of the figure's occluded contour (see also Keane et al., 2007). The discrimination of the global shape of a figure as thick or thin depends on representing small segments of the figure's boundary, including occluded segments. When random noise is introduced in the same area as those represented segments, the representation of the segments is impaired and therefore the discrimination of the whole figure is affected.

Neurophysiological evidence corroborates the claim that the visual system specifically represents occluded, connecting fragments of things. Areas V1, V2, and V4 of the visual cortex, as well as the lateral occipital complex (LOC), are all implicated in the representation of the shapes of objects and parts of their bounding contours (Pasupathy et al., 2018). In all of these areas, neural populations that are dedicated to representing segments of the *visible* bounding contours of objects at specific locations have been demonstrated to show comparable activity even when no relevant stimulation is received from that location, so long as there is evidence of occlusion. When a stimulus feature is occluded, the visual system does not receive *local stimulus cues* that arise directly from that stimulus feature. Neural activity that corresponds to occluded stimulus features instead depends on *contextual cues* that arise from surrounding parts of the scene and which indicate the occlusion of the stimulus feature in the relevant location.

To take just one example, Ban et al. (2013) conducted a neuroimaging study in which subjects viewed a wedge-shaped figure continuously rotating about its thinnest point at a fixed speed, like a hand on a clock-face, as illustrated in Fig. 4. In a "transparent" condition, translucent patches were introduced at opposite locations in the display, each patch obscuring the mid-section of the wedge whenever it swept underneath. In an "occluded" condition, these patches were made to be fully opaque, so that at certain points as the figure rotated around the screen, one could see the top and bottom of the object but not its mid-section. In a "divided" condition, there were no occluding patches and the mid-section of the figure was simply deleted so that the disconnected top and bottom rotated around in common motion. Ban et al. identified specific retinotopic areas in V1 and V2 that responded to just the region of the visual field occupied by the occluding patches. Using the transparent condition as a baseline, they identified evidence of periodic neural activity that occurred just when the wedge was sweeping underneath the translucent patches. They found similar traces of periodic activity in these areas in the occluded condition but not in the divided condition. In other words, neural activity was phase-locked to the presence of the wedge's

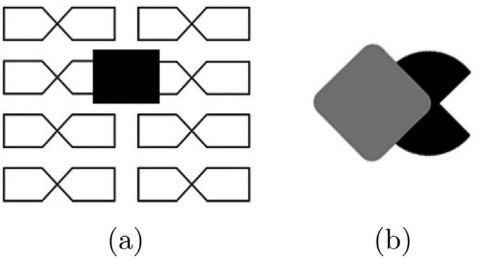


FIGURE 5 Examples of local, rather than global, completion. The visual system tends to process these stimuli in accordance with local regularities of contours (that neighboring contour segments tend to be smooth continuations) rather than regularities of global shapes (which tend to be symmetrical). Reproduced from Carrigan et al. (2016) with permission from the American Psychological Association

mid-section underneath an occluder. The facts that the neural activity was similar to that in the transparent condition and was in phase with the periods of time when part of the stimulus became occluded suggests that this activity coded for the periodic presence of the occluded part of the stimulus in the relevant area of the visual field. Since the neural activity was periodic, it is unlikely that the activity was merely a response to the presence of the static occluding patches. And since no such periodic activity was found in the divided condition, when there were no cues indicative of occlusion, it is unlikely that these neurons were responding to just the visible top and bottom of the wedge—indeed, early visual receptive fields are too small to register both the visible top and bottom of the wedge. So, given the appropriate contextual cues it appears that neural activity can encode the presence of a completely occluded fragment of the stimulus (see also Sugita, 1999; Bakin et al., 2000; Murray et al., 2004; Thielen et al., 2019).

Finally, an adequate computational explanation of visual completion will likely include computations that are defined over representations of occluded fragments. In many cases, the completed boundary shape one experiences a partially occluded figure as having tends to be the one with the smoothest curve, having the fewest inflections, that connects the visible fragments (Takeichi et al., 1995; Fulvio et al., 2008; de Wit et al., 2008). The computation of smooth continuations involves encoding the local properties of and relations between segments of an object's boundary and very likely relies on operations that take visible boundary segments as inputs and produce representations of hidden segments among their outputs (see, for example, Fantoni & Gerbino, 2003; Kalar et al., 2010).

Irrespective of the exact form that a computational model of interpolation takes, it is plausible that interpolation according to some principle of smooth continuation functions to yield representations of the features of and relationships among segments of contour, both visible and hidden. Smooth continuation is defined over local segments of an object's boundary, rather than an object's global shape. Computations that abide by some principle of smooth continuation provide an optimal way of reliably representing object boundaries given the statistics of small boundary segments. Far more often than not, adjacent segments on a bounding contour are smooth continuations of each other (Geisler et al., 2001; Elder & Goldberg, 2002; Geisler & Perry, 2009). Smooth continuation does not, however, reflect the global statistics of whole objects. Whole objects tend to be more symmetrical than the principle of smooth continuation would sometimes suggest. Where global symmetry demands a sharp corner, smooth continuation calls for a smooth, uneventful curve. As Fig. 5 illustrates, completed shape experiences sometimes abide by smooth continuation even at the expense of global symmetry. In following the principle of smooth continuation, visual processing reflects and is well-explained by the statistics of contour segments rather than

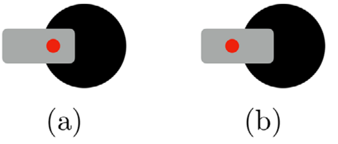


FIGURE 6 An illustration of "dot localization" stimuli, in which the task is to indicate whether the small dot is on the inside or outside of the occluded boundary

the global statistics of whole shapes. It is plausible, therefore, that the visual states that result from computations of smooth continuation function to encode or be about contour segments, both visible and occluded, and not merely global shape.

To be sure, we sometimes do experience partially occluded objects as having shapes that conflict with smooth continuation (van Lier & Gerbino, 2015; Yun et al., 2018). But there are psychological differences between the types of cases in which one represents the whole shape of a figure in accordance with global shape principles such as symmetry and the cases in which one represents a shape by following a more fine-grained procedure of filling in the local positions, curvatures, and so on of occluded fragments. More globally informed completion experiences tend to arrive later in development (de Wit et al., 2008) and tend systematically to be less precise than experiences based on smooth continuation. In the "dot localization" paradigm, developed in Guttman and Kellman (2004), subjects are presented with a display depicting one surface partly occluding another. A dot then appears over the occluder (as in Fig. 6) and the subject is asked to indicate whether or not the dot is located to the left or right of the occluded segment of that surface's boundary. Subjects are able to accomplish this and similar tasks with great precision when the visible fragments can be smoothly interpolated. Responses are significantly less precise when they depend on global cues such as symmetry (Carrigan et al., 2016; Fulvio et al., 2008). The greater precision and reliability of smooth continuation makes ecological sense: the statistical regularity that contours tend to extend smoothly is far more robust and precise than the regularity that objects are often somewhat symmetrical. The fact that interpolation by smooth continuation has distinct psychological signatures than mere global completion bolsters the case that the visual system has capacities to encode features of occluded fragments of things according to something like a principle of smooth continuation. These capacities facilitate, but are distinguishable from, the encoding of global features of complete objects in accordance with principles such as symmetry.

It is an open question how the visual system circumscribes the visible and occluded fragments that it encodes—how it differentiates one piece of an object from another. The size, location, color, and orientation of the fragment play a role. Differences in curvature likely also play a signifiant role, so that the wire depicted in Fig. 1a may be represented in terms of two straight segments and an occluded curved segment (Kellman et al., 2013). Irrespective of these details, the above considerations together suggest that the shapes of partially occluded objects are often coded partly in terms of the specific features of their occluded fragments.

1.2 | Visual experience

The previous subsection argued that visual information-processing systems encode specific occluded features, such as the curvature of the hidden part of the wire in Fig. 1a. What I now

FIGURE 7 (a) Observers will typically "amodally" interpolate a curved contour that connects the white segments (figure based on Kellman & Shipley, 1991, p. 179–180). (b) A Kanizsa triangle

want to argue is that the encoding of those hidden features can correspond to aspects of conscious visual experience. If hidden features can figure into conscious experience, this suggests that these features are not merely the domain of sub-individual information-processing but can enter into the whole individual's awareness. To be sure, visual interpolation might not always result in conscious experiences of hidden features. Moreover, I do not mean to suggest that an individual can only be aware of something if she is consciously so. The claim here is just that occluded features of things *can* (and often do) correspond to aspects of an individual's conscious experience and that therefore it is appropriate to say that the whole individual, and not merely their visual sub-systems, can be aware of occluded features.

The perceptual interpolation of occluded elements is commonly said to be "amodal" and lacking in phenomenal character, in contrast to the "phenomenal contours" that are said to arise from the "modal" interpolation of partially camouflaged objects such as the Kanizsa triangle or the curved white figure depicted in Fig. 7.[5] The idea that amodal interpolation, in contrast to modal interpolation, lacks any conscious character is somewhat puzzling. It is widely, though not uncontroversially, thought that modal and amodal interpolation rely on common mechanisms. Moreover, the evidence that the visual system encodes occluded features broadly replicates evidence that the visual system encodes certain camouflaged features. Why, then, would interpolated features be consciously experienced only in cases of partial camouflage? In what follows, I will argue that there is no such disanalogy. Though amodal interpolation gives rise to a different phenomenology than modal interpolation, it nevertheless does contribute to phenomenology: occluded features can figure into the character of visual experiences.

We certainly do not experience hidden parts of a scene in the same way that we experience visible ones or modally interpolated ones. Nevertheless, hidden parts of the scene correspond to real, distinctive features of visual phenomenology. One way to isolate which features of a scene are consciously experienced is by investigating the phenomenal similarities and contrasts between experiences (Siegel, 2010). Note that one's experience of the partially occluded wire depicted in (a) in Fig. 1 is similar in some respect to one's experience of the fully visible, smoothly bent wire in (c), but differs significantly from one's experience of the fully visible crimped wire in (d) and from one's experience of the disconnected segments in (b). These similarities and differences would be especially pronounced with the addition of depth cues and if the two lines were sliding up and down in common motion behind the occluder. What is the best explanation for these patterns of phenomenal similarity and contrast? Briscoe (2011, p. 156) writes, "the phenomenally most salient characteristic of amodal completion is the perceived unity of the partially occluded

[5] For criticism of this interpretation of the term "amodal" as it occurs in "amodal interpolation," see Kellman, 2003; Scherzer & Ekroll, 2015; Nanay, 2018.

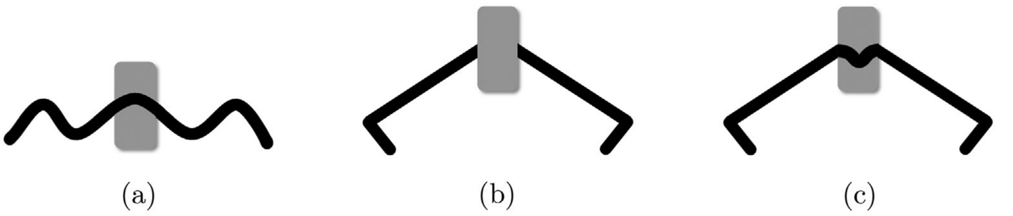


FIGURE 8 There is a local respect in which one's experience of the partially occluded figure in (b) is more similar to one's experience of the black figure in (a) than to one's experience of the black figure in (c), even though the experiences of (b) and (c) are more similar on the whole

object." But our phenomenology goes beyond unitization. There is a clear phenomenal contrast between one's experience of the occluded wire depicted in (a) and one's experience of the crimped wire depicted in (d). At the same time, one's experience of the partially occluded wire does not contrast as strongly with, and is even similar in important respects, to one's experience of the fully visible bent wire depicted in (c). These experiences do not differ, however, with respect to whether one is experiencing a unified object. In (a), (c), and (d) alike, one experiences the visible parts of the wire as belonging to a unified whole. To explain why the experience of (a) is similar to that of (c), but not (d), we must appeal to how one experiences the *shapes* of these wires.

A possibility is that in experiencing the shape of a partially occluded object, one only experiences the complete shape of the whole object and no distinctive part of one's experience is specifically dedicated to the shape of the occluded part. Even if there are visual processes that differentiate the hidden curve from the visible straight lines, it may still be that in one's phenomenology these parts are "glued" together into a non-decomposable experience of the whole shape. But now consider Fig. 8. One experiences the overall shapes of the wires as quite different from each other. On the one hand, one's experience of the partially occluded wire in (b) is more globally similar to one's experience of the fully visible wire in (c) than to that in (a). On the other hand, there is *a certain respect* in which one's experience of the wire in (b) is more similar to one's experience of the wire in (a) than to one's experience of the one in (c). Namely, I suggest, one experiences the central occluded part in (b) as curved in approximately the same way as the central bump in (a). The phenomenal similarities and contrasts here have to do with one's experience of the shape of specific parts of the wire—their bumps and crimps. In the case of (b), the relevant part that one's experience characterizes is occluded. One's experience of (b) is more similar to that of (a) than to that of (c) with respect to the experienced curvature of the occluded part. One cannot plausibly explain this aspect of the phenomenal similarity between (b) and (a) in terms of one's experience of the global shapes of the wires.

The visual system does not just encode the features of occluded segments of things; these features can be presented in conscious visual experience. While there is reason to believe that hidden features of objects can be represented unconsciously (Emmanouil & Ro, 2014)—they do not *need* to be present in conscious experience—there is strong reason to believe that these hidden features can be and regularly are experienced consciously. The way objects look to us can depend in part on how we consciously experience certain occluded parts of those objects.

To say that occluded features of fragments of a scene have corresponding phenomenal character is not to say that these features are as phenomenally salient or as ecologically important as whole objects, say (see Siegel, 2006; Green, 2018; Matthen, 2019). We do not regularly "notice" occluded features of things or orient ourselves specifically to those features. These features tend to have little intrinsic value to organisms outside of their value in supporting the reliable processing and experiencing of whole, ecologically significant objects. For all that, the processing and experiencing of whole objects does involve processing and consciously experiencing these fragmentary features.

It is worth emphasizing as well that in saying that one can visually experience the shape of an occluded part of the scene, I am not denying that that this experience is significantly different in kind from one's experience of a visible part's shape. Occluded parts of the scene do not look the same as unoccluded ones. But it does not follow that one lacks any conscious experience of the specific features of the occluded element or of its differentiation from the background. Nihilism about the phenomenal character of amodal interpolation cannot explain relevant patterns of phenomenal contrast and similarity. Even though they are experienced in different ways and perhaps with different levels of detail, occluded features are just as much part of our visual experiences of the world as their unoccluded counterparts.

Some hold that there is a phenomenology associated with occluded features of a scene while still designating this phenomenology as distinctively "non-visual" or "non-sensory" in character. I will presently argue that the phenomenology of occluded features is perceptual, as opposed to cognitive or merely sensory. But some hold that perceptual completion is genuinely perceptual in this sense, while still denying that these cases have a fully "visual phenomenology" (for example, Smith, 2010; Briscoe, 2011). There is, I think, a good deal of difficulty in specifying just what it means to have or lack a "visual" phenomenology in this sense, if this is to imply something more than that experiences of occluded features do not have the same character as experiences of their unoccluded counterparts. Still, what matters for the present argument is just that occluded features do figure into an individual's perceptual (not just cognitive, say) awareness of the world.

1.3 | Perceptual status

One possible objection is that the experience of occluded features is not part of *perceptual* experience. This reply can come from either of two directions. On the one hand, one might argue that interpolation is a feature of early sensory processing, not of objective perceptual experience. On the other hand, one might hold that the experience of occluded parts is entirely a product of post-perceptual cognitive capacities. I do not intend to offer a general account of what distinguishes perceptual from non-perceptual capacities. I will confine myself here to considering two archetypal arguments that interpolation is not perceptual.[6]

Burge (2010) notes that not all capacities for "extraction of form" from a patchy stimulus function to yield percepts of objective, distal features of the world. Low-level sensory processes might

[6] Nanay (2010, 2018) argues that completed parts of the scene are represented through mental imagery. He holds that completion does not give rise to a *perception* of the occluded parts of the scene for, he says, we do not have a causal connection to those parts. At the same time, he holds that mental imagery consists in *perceptual* processing that occurs in the absence of "corresponding stimulation" on the retina: "Perception is perceptual processing triggered by corresponding sensory stimulation in the relevant sense modality. But perceptual processing does not have to be triggered by corresponding sensory stimulation in the relevant sense modality—in the case of mental imagery, it is not" (Nanay, 2018, p. 7). Nanay's position is therefore consistent with the claim here that interpolation is *perceptual*, even if it does not constitute what he calls *perception*, just as one might count an hallucinatory experience as perceptual without implying that it constitutes perceiving. It is a further question, which I will not address here, whether this type of perceptual processing should in addition be classified as mental imagery, as Nanay proposes.

fill in missing information from a lossy registration of the retinal image by averaging and pooling over registrations of proximal information or by comparing these registrations to stored patterns of proximal stimuli. In such cases, Burge suggests, "[n]o objectification that distinguishes proximal stimulation from objective environmental affairs need be in play" (Burge, 2010, p. 418). Insofar as these processes do not operate according to principles that distinctively pertain to the nature of specific distal features, they do not function to fill in hidden parts of the objective scene so much as to fill in *proximal* information.

Burge's concern here is to argue that the "extraction of forms" that are underspecified in the retinal image is not sufficient for objective perception. However, he does not argue that all interpolation is pre-perceptual. Indeed, the core processes of surface and contour interpolation that I have been discussing are convincing examples of what Burge calls "objectification": they constitute the formation of states with representational contents that are "*as of* a subject matter beyond idiosyncratic, proximal, or subjective features of the individual" (Burge, 2010, p. 397). Contour interpolation processes operate on proximal cues, such as the presence of "T-junctions" in the retinal image (Kellman & Shipley, 1991; Nakayama et al., 1995; Rubin, 2001). These cues are explanatorily significant only in virtue of specific facts about features in the distal environment. For example, T-junctions are significant because they often arise in images of partly occluded figures. In Fig. 1a, for example, the visible black segments each project the "stem" of a T-junction while the sides of the gray surface each project the "hat" of a T-junction. Kellman and Shipley (1991) argue that a pair of visible fragments will be treated as a unit only when they project the stems of T-junctions and when the visual system determines that the fragments are "relatable." Roughly, visible fragments of the wire are *relatable* if and only if straight-line extensions of the visible fragments would intersect at an angle greater than or equal to 90°. Suppose the visible segments of wire were each extended in a straight line beyond the point of occlusion. These lines would intersect underneath the gray surface at an angle greater than 90°. Hence, the visible segments are relatable. Crucially, relatability "reflect[s] important aspects of the physical world as it projects to the eyes.... Two visible edge segments associated with the same contour meet the mathematical relatability criterion far more often than not" (Kellman et al., 2005, pp. 589–90). Mathematical relatability is a psychologically significant cue in virtue of systematic facts about distal contours. General patterns among distal contours not only enter into explaining when we interpolate, they enter into explanations of how we interpolate. As I argued above, we tend to perceive relatable fragments as connected by such "smooth continuations," in accordance with the actual statistics of distal contours.

Indeed, smooth continuation operates on and yields representation of elements in depth (Kellman et al., 2005; Fantoni et al., 2008). When we experience parts of an object as connecting behind an occluder, what we experience is the smoothest connection as defined in three-dimensional space, based on the visual system's representation of the locations, orientations, and curvatures of visible parts in depth. Boundary interpolation addresses the problem of how to fill in the hidden parts of a distal scene on the basis of retinal stimuli that could have arisen from many different distal configurations. Boundary interpolation solves this problem by capitalizing on regularities in the optics of occlusion and the local structure inherent in distal objects. This form of interpolation is not merely a low-level, pre-perceptual image-processing capacity. It is a substantially world-based and world-oriented capacity.

An objection from the other end is that the experience of occluded features is an aspect of post-perceptual cognition. In Fig. 9a, one seems to experience a whole cat complete with legs and a torso. But one's experience surely depends on dispositions to recognize cats and on one's background memories and beliefs about what they look like. Perhaps the phenomenology of occluded

(a) (b)

FIGURE 9 While the completion experience in (a) depends on recognitional dispositions and background beliefs, these seem to be flaunted by one's completion experience of (b). Adapted from Carrigan et al. (2016) with permission from the American Psychological Association

parts of the cat is fully exhausted by the phenomenology of exercising these recognitional dispositions and beliefs.

Let us bracket the question of whether there is a "cognitive phenomenology" affiliated with the exercise of recognitional dispositions and beliefs (Smithies, 2013). The objection faces the problem that many cases of interpolation are insensitive to background beliefs and recognitional dispositions. When looking at the scene depicted in Fig. 9b, one tends to experience the cat's head as attached to the bulbous shape underneath it and the tail as attached to the hook below, even though this configuration does not facilitate the recognition of a familiar kind and is highly improbable (grotesque even) in light of our background beliefs about cats (Kellman et al., 2005; see also Nanay, 2010; Briscoe, 2011). Keane et al. (2012) found that often when cues to smooth continuation are strong, explicit beliefs and intentions have little effect on the visual processing of occluded parts (see also Keane, 2018). Indeed, the phenomenology of hidden parts is arguably stronger and more vivid for Fig. 9b than for Fig. 9a. Using the dot localization paradigm described earlier, Carrigan et al. (2016) showed that hidden contours are localized much more precisely when they are experienced as smoothly connecting visible parts at the expense of recognizability than when they conform to recognizability though at the expense of smoothness. Smooth continuation can guide interpolation even at the expense of recognizability and background expectation.

The sensitivity of a mental state to cognitive states and background beliefs is sometimes taken to be evidence that the state is itself a cognitive state. Background beliefs and recognitional dispositions can influence one's experiences of completed objects in certain cases. But these cases are not exhaustive. In other cases, relevant background beliefs have little influence on perceptual completion. Some have gone so far as to suggest that recognition-based completion is simply a different kind of capacity than interpolation—what might be called "recognition from partial information" (Kellman, 2001), "cognitive completion" (Briscoe, 2011), or "contour abstraction" (Keane, 2018). Perhaps an argument can be made from the belief-sensitivity of this latter kind of capacity to its being post-perceptual. However, such an argument is a nonstarter for a core set of cases in which interpolation is quite insensitive to recognitional dispositions and background beliefs.

2 | *DE RE* AWARENESS OF HIDDEN PARTS

I have argued that one can visually represent and experience features of occluded parts of a scene. In experiencing these features, is one visually aware *de re* of particular occluded parts of the scene, such that one's experience functions to be accurate of these specific parts and no others? Or does one merely experience the scene or object as containing *some* occluded parts with such-and-such features? One central motivation for thinking that we cannot be aware *de re* of particular occluded parts of a scene is that our experiences of occluded features seem not to have any causal relationship to those features themselves. A highly plausible condition on being perceptually aware of a particular item is that the item be causally related (I would add: in an explanatorily significant way) to one's experience of the item. For example, Strawson argued that a central condition on being perceptually aware of a particular item is that the presence of that item partly "account for," or "be responsible for," one's perceptual experience of it (Strawson, 1979, p. 51; see also Grice, 1961; Goldman, 1977; Sorensen, 2008; Burge, 2010). It is one's causal relation to the item that allows one to be aware of *it* in particular, even if the item does not uniquely possess all the properties that one experiences it as having (Burge, 1977; Bach, 1987). But experiences of occluded parts are not caused by the registration of light from those parts. This has led many to conclude that occluded parts of a scene are "not causally responsible for any visual information" (Nanay, 2010, p. 242). In the absence of some causal relation to the occluded part of the scene, it would seem that one can only experience it in a general way as whatsoever has the properties one experiences.

I will argue that vision does exploit stimulus information about the presence and nature of occluded fragments in the scene and that normally this information causally depends on those fragments themselves. I should be clear that I do not intend to offer sufficient conditions on *de re* awareness here. I focus on the existence of a causal-informational link to occluded parts of the scene because such a link is widely held to be a necessary (if not sufficient) condition on *de re* awareness of an item and because such a link is widely assumed not to exist when the experienced features are occluded. The conditions on being a singular or *de re* mental state are notoriously difficult to pin down (see the contributions to Jeshion, 2010). I only offer considerations of plausibility and of parity with the ways in which one can be visually aware of visible things.

As I understand it, three conditions are implicit in the causal requirement on being visually aware of an item. First, one's being in a given visual state must causally depend in some explanatorily relevant way on an event or state involving the item of which one is aware. Second, this causal relationship must enable one to gain information about the item. The causal relationship must be "epistemically rewarding," as Recanati (2012) puts it. And third, the causally derived stimulus information about the item must be operative, must play some systematic controlling role, in the formation of one's experience of that item (Evans, 1982). Each of these conditions is satisfied in normal cases of interpolation. Visual interpolation functions to exploit certain stimulus cues in virtue of the way those cues systematically causally depend on occluded parts of the world.

The first point, that there is an explanatory causal relationship between one's filled-in experience and occluded parts of the scene, is the most controversial and is frequently dismissed out of hand. Occluded parts of a scene do not reflect light to the eye. Instead, interpolation causally depends on the registration of patterns in the light reflected by certain configurations of visible parts of the scene. However, these configurations of visible parts of the scene normally depend, at least in part, on the states of occluded parts of the scene.

Recall that standard stimulus cues for interpolation include the presence of "T-junctions" in the retinal image, which indicate that one surface is occluding another. In interpolating the occluded portion of an object's boundary, the visual system estimates the geometric relatability (as described above) between the represented three-dimensional positions and orientations of the visible parts of that boundary. Normally, the occluded contour is what binds the visible contours together into a relatable configuration that in turn induces perceptual interpolation.

Suppose one is viewing the scene depicted in Fig. 1a, in which the wire continues behind the gray surface. The pattern of light coming from the visible segments of the wire depends on how those visible segments are arranged. In turn, how those visible segments are arranged depends on whether or how they are connected by the segment that happens to not be visible. If the occluded segment had not existed, or had not connected the visible segments, or was curved in a different way, or was located in a different place, it would be extraordinarily improbable that the visible segments would be arranged just as they are and that they would abut the gray square without any visible gap. The state of the occluded fragment—its existence, shape, position, and so on—plays a role in determining the states of the of visible fragments. The visible fragments are arranged as they are in part *because* of the presence and nature of the hidden connective fragments.

The causal dependence of the visible configuration of parts on the hidden connective tissue is perhaps most vivid if one considers scenes from a more dynamic perspective. Do not think of the partially occluded wire depicted in Fig. 1a as just pinned statically in place for all time. Rather, suppose that the wire is where it is because it has been moved or dropped there at some point in the past. The visible parts of the wire have moved through space and time to get to where they are now. But the connecting segment—the segment that is now occluded—surely played a role in keeping the visible segments in a regular arrangement throughout their travels. If that segment were obliterated, the visible pieces would only have landed where they did by accident. Or suppose the wire is moving up and down behind the occluder. The two visible segments move in common motion because they are connected in a certain way behind the occluder. Perturbing the path of one fragment has an effect on the path of the other by way of having an effect on the path of the connecting fragment. A strong causal inference can therefore be made from the common motion of visible parts to the presence and existence of a hidden connective structure. The strength of such an inference likely corresponds to the fact that dynamic displays induce some of the developmentally earliest and phenomenally most vivid experiences of occluded features.

Even in static cases, it is clear that the states of the occluded parts play a causal role in sustaining the arrangement of visible parts at that moment. If the wire is being held up in the air at one of its visible ends, the hidden connecting part helps explains why the other end takes the position that it does on the other side of the occluder. Holding one end up causes the other end to stay up, by way of causing the intervening connective tissue to stay up. When one views a partially occluded telephone wire or bridge, the occluded parts that one cannot see play a causal role in the configuration of the visible parts. Without those connecting parts, the visible parts of the wires would drop to the ground; the bridge would collapse. In all these cases, the stimulus patterns that drive interpolation arise from visible configurations that in turn depend causally on the hidden connective tissue of the scene. So, in all these cases one's experience of occluded features causally depends in part on the presence and nature of occluded parts of the scene.

Crucially, unseen fragments of a scene causally sustain visible arrangements in ways that are systematic and reliable. When visible segments of contour are relatable and participate in T-junctions, it is often because there exist occluded segments that smoothly connect the visible ones. Hence, stimulus patterns that arise from these arrangements of visible parts provide contextual information about the presence and features of the occluded parts. The ways in which hidden parts causally sustain visible configurations enable one to gain information about the presence and features of those hidden parts. So, the second condition is fulfilled: the causal dependencies of certain configurations, such as the presence of relatable edges that project to T-junctions, on occluded parts of the scene enable the visual system to harvest information about those parts of the scene. The causal relation between stimulus patterns and occluded parts of the scene is epistemically rewarding.

The third condition obtains as well: not only do there exist epistemically rewarding causal relations between features of the sensory stimulus and occluded parts of the scene, it is those very relations that normally play an operative role in the experience one comes to have of occluded features. In interpolating hidden contours, visual processing relies on exactly the cues that normally systematically depend on hidden parts of a scene. Visual interpolation functions to encode occluded features on the basis of cues that ultimately depend on the nature of occluded parts.

It should be uncontroversial that the contextual stimulus cues that play a controlling role in how the visual system fills in the scene carry information about occluded parts of the scene. As Briscoe points out, echoing Gibson (1966), "the information available to the visual system for the existence of an object-feature is not limited to the feature's projection in the retinal image" (Briscoe, 2011, p. 161). Interpolation processes exploit certain contextual cues because they are informative about the features that are to be interpolated. But it is important also to appreciate that these cues are informative about occluded parts of the scene because in normal circumstances those cues systematically causally depend on the parts of the scene about which they carry information. When interpolation is successful, it is because it exploits cues that do in fact causally depend on the hidden parts of the object whose features are being interpolated.[7]

I want to pause now to clarify these points in light of some potential reactions. First, I have argued that the occluded parts of a scene can be part of the causal story that leads to one's experiencing occluded features. But all sorts of other things will enter into that causal story too. There is the person, say, who left the wire underneath the notecard. There is the factory that made the wire according to a standard blueprint—a common cause of the entire wire's shape. Not to mention the photons reflecting off of the wire, to which one's photoreceptors respond. And if we just focus on what keeps the visible arrangement of the wire together, any of the visible connecting bits are just as influential as the hidden ones in sustaining that arrangement. Not only do the parts that happen to be hidden play a causal role in holding together the visible parts in some stable relationship, the states of the visible parts can play a causal role in the position, shape, and movement of the parts that are hidden. One might worry, then, that the causal influence of the hidden fragments does not stand out enough, in some sense, to anchor one's awareness to those fragments. In response, it is worth emphasizing that the causal dependencies of visible arrangements on the hidden connective tissue are systematic and reliable. Moreover, we have identified visual processes that function specifically to exploit the systematic ways in which stimulus cues causally depend on the occluded fragments in the scene. The causal influence of the hidden fragments on contextual stimuli is psychologically significant: there are visual processes that are geared to compute representations of occluded features precisely on the basis of the types of systematic effects that those fragments have on the other parts of the scene.

This point bears on another potential response. Why carve up the relevant causal objects so finely, into the visible and occluded parts of the object? A different way of telling the causal story is that it is the state of the *whole object*, not the different fragments, that causally explains one's visual state in the relevant way. I think that this redescription is harmless, so long as we recognize

[7] Ganson (2020) suggests that while contextual cues in the visual stimulus carry information about occluded parts of the scene, they do not do so in virtue of causally depending on those parts. His aim is to relax the requirements of a causal theory of perception: one's experience need not causally depend on the object of perception so long as the experience is causally correlated with that object, perhaps by way of some common cause. He focuses on cases of perceptual "extrapolation," in which one experiences a partially occluded surface as extending behind an occluder without reappearing on the other side. In these cases, "our visual system exploits cues in order to reveal occluded parts of objects. Our successful perception of these occluded surface areas is not causally dependent on the parts seen" (Ganson, 2020, p. 690). (Context makes clear that by "the parts seen" Ganson means the occluded parts that one experiences.) Ganson simply assumes that there is no causal dependency between one's experience and the occluded parts of the scene. While I have not discussed perceptual extrapolation, I have argued that there normally is such a causal dependency in cases of perceptual interpolation.

that the whole object has a causal role in inducing interpolation insofar as the object is constituted by particular occluded parts that have certain features and stand in certain relations. What we can say is that one's experience of an occluded feature causally depends on this object *having this particular occluded part that is in a certain state*. It remains true, on this description, that one's experience of the occluded feature causally depends, in an explanatorily significant way, on a state of affairs that involves this particular occluded fragment of an object. A normal causal explanation of why the object produced the stimulus that led to the interpolation of certain occluded features would make reference to the features of the particular occluded fragment of the object.

Another worry might have to do with the mediated character of interpolation. Any contextual information about the occluded part derives, first and foremost, from information that causally stems from a visible part. It is in virtue of registering information about visible parts and representing their distal positions and orientations that one forms an experience of the occluded parts of the scene. Now, it cannot be a requirement on *de re* awareness of an item that there be no causal intermediaries between the item and one's visual state—if that were the case, then one could never be aware of distal objects in the world. But the worry is not just that there are causal intermediaries between the occluded part and one's experience. It seems that one can only form an experience of the occluded part of the wire if one is *aware of*, or represents, its visible parts. To experience occluded features of the wire, one must at least be in a visual state that represents the distal positions and orientations of related visible parts. I accept this dependency and will argue for it in the next section. It is nevertheless unclear why such a dependency would undercut one's capacity to also be aware of the occluded part on which the arrangement of visible parts depends. Put another way: it is unclear why mediate awareness of an item—an awareness which depends on awareness of some other item—should be impossible. Mediate awareness does not conflict with the causal requirement outlined above.[8]

Finally, and relatedly, one might worry that really what is doing the causal work in producing one's experience is just the arrangement of visible parts. So long as the visible arrangement is as shown in Fig. 1a, one will experience a hidden connecting fragment whether or not there really is one. So how, the worry goes, can the hidden fragment play a causal role in one's visual state? But if this is a worry, it is a version of a more general worry that applies to all of perception: when one holds certain stimulus cues and/or distal conditions fixed, the distal parts of the scene that one seems to experience no longer display any causal control over one's experience. Such occasions give rise to perceptual illusions or mistakes in which one becomes causally disconnected from the distal entities one seems to experience. I take such occasions to be fully compatible with the claim that on other normal occasions, distal parts of the world do play a causal role in one's experiences. Likewise, the fact that one can have an experience as of an occluded part when none exists does not entail that occluded parts never play any causal role in the formation of one's experiences. The more immediate point, however, is that the causal influence of occluded parts on one's perceptual experience is on a par with the causal influence of *visible* parts of the scene. It is not a distinctive feature of visual interpolation that it is not always under the causal control of the relevant distal parts of the scene.

I have defended the claim that our visual experiences of occluded features can, and normally do, derive from information that systematically depends on particular occluded parts of the scene. While one might want to impose further conditions on *de re* awareness, I am not aware of any that

[8] Bermúdez (2000) offers a helpful discussion of these issues. He discusses the ways in which one's awareness of an item (a whole object, say) can depend one's awareness of distinct, though related, items (for example, the facing surface of the object).

the experience of visible parts of a scene can meet yet the interpolated experience of occluded parts cannot. Whatever considerations favor the particularity of our experiences of visible parts of objects seem also to favor the particularity of our experiences of certain occluded parts. For example, Dretske (1969) and Siegel (2006) emphasize the importance of differentiating the object of awareness from its background. I argued in the previous section that our experiences do differentiate occluded parts of the scene from their background. Following Strawson (1959) and Evans (1982), another commonly proposed requirement is that one be able to "re-identify" the item of which one is aware or else track it as it moves and changes (Dickie, 2011; Green, 2017). Much has already been made of the attentional capacity to track whole objects as they move behind occluders; but we also have visual capacities to track partial fragments of objects as those fragments move, change, and become visible or hidden. Spatiotemporal interpolation occurs when, for example, one views a firetruck passing behind the obstructing foliage and branches of a tree (Shipley & Cunningham, 2001; Palmer et al., 2006). Different parts of the truck's facing surface are occluded at different times, some never coming into view at all. Experiencing a complete object behind the tree and experiencing it as the same object through time involves maintaining in perceptual memory visual content about the distal features of particular occluded parts, updating this content with respect to the objective positions, shapes, colors, and so on of those parts, and placing that content in correspondence with newly incoming content about those parts. Unlike the tracking of whole objects, the tracking of occluded fragments is not salient or voluntary. Such tracking perhaps cannot be characterized as a mental action that the whole individual undertakes. Nevertheless, even if the tracking is done by sub-individual systems, those systems ensure that the individual's experience is fixed to a moveable, changeable part of the scene.

While I have not offered sufficient conditions on being aware of a particular part of a scene, I hope to have made it plausible that conditions that are widely thought to be necessary are satisfied in successful cases of visual interpolation. Occluded parts of a scene have a systematic causal role in the sorts of visible arrangements that produce the stimulus cues for visual interpolation. Visual interpolation functions to exploit this causal role. When interpolation is successful, it is successful because one's experience of the occluded part of the scene derives from information that causally depends on that very part of the scene. Moreover, occluded parts are visually distinguished in one's experience and the visual system tracks them as they move and change. Interpolation does not merely function to characterize objects as having *some* hidden parts with certain features. Interpolation functions to characterize the *particular* hidden parts of the object that are responsible for the arrangement of the object's visible parts.

3 | SEEING

I have argued that one can experience and be visually aware of particular occluded parts of the scene. If, however, one does not *see* occluded parts of a scene, then it follows that one can be visually aware of—one can have experiences of—particular elements in a scene that one does not see. To complete the argument, then, it remains to argue that one does not see hidden parts of the scene. But one possible reaction to the argument so far is to conclude that one *can* see certain occluded parts of a scene after all, insofar as these parts of the scene can contribute to one's visual experience. Munton (2021) argues that we see invisible objects when we track their movement behind an occluding surface. Ganson (2020) has likewise defended the claim that we see occluded parts of objects—that those parts are in some sense *visible*. In the psychological literature, Kellman has argued that we should not "confine the meaning of *seeing* to local sensory responses based on local physical data" (Kellman, 2003, p. 922). By contrast, some go so far as to suggest that this liberalism about what can be seen is conceptually incoherent. For example, Child writes, "If one has the concept of vision, one knows that *S* will stop seeing something if he shuts his eyes, or if we interpose something opaque between him and the object" (Child, 1992, p. 311). While I do not think that the claim that one sees occluded parts of the scene is conceptually incoherent, still the intuition that one cannot see what is occluded has explanatory value. What our experiences are of is not confined to what parts of the scene produce "local physical data" at the eye; at the same time, a narrower concept of *seeing*, according to which one can only see what produces such local stimulations, is indispensable for explaining our broader capacity to be visually aware of things.

One's visual awareness of particular occluded parts of a scene depends asymmetrically on one's awareness of the particular visible parts to which they are related. Consider, first, the conditions for forming representations of occluded features—setting aside the question of which items those representations are about. The visual system will not represent occluded features at all and those features will not figure into conscious experience unless the visual system represents the features of the visible context. Recall that interpolation depends on determining the relatability of the positions and orientations of distal fragments that do cast light to the eye. The visual system must not only register the light coming from the visible context, but it must form representations of the positions, orientations, color, texture, and so on of the distal parts that cast that light. Interpolation does not get off the ground without representing distal features of unoccluded parts of the scene.

Moreover, *which* particular occluded fragment one is aware of in a scene depends on which particular visible fragments one is aware of. The occluded part only plays a role in the formation of one's interpolated experience if it is responsible for the particular arrangement of distal visible items that stimulated the formation of that experience. One's causal-informational relationship to the occluded part depends on one's causal-informational relationship to the related context that produces stimuli at the eye. If one merely hallucinates the unoccluded parts of the wire in the scene illustrated in Fig. 1a, then one will not be in any position to be aware of the occluded part, even if such a part exists and even if it has exactly the shape, size, color, and location that one's experience indicates. If one's experience as of visible features does not depend on and is not about parts that are actually held together by the occluded parts of an object, then the occluded parts will not play any genuine role in explaining the interpolation of hidden features on that occasion. Awareness of the visible context is necessary to satisfy the causal requirement for visual awareness of the occluded part.

While I have argued that one can be visually aware of occluded parts of the scene in virtue of standing in causal relationships to those occluded parts, seeing an item requires a specific, more restrictive kind of causal-informational relation. To see an item, one's awareness of the item must depend on the registration of local cues from that item itself—for example, patterns of light reflected by the item or patterns of contrast reflected by the boundary between the item and its background. There is no reason that this sort of causal relationship to an item should be necessary in general for awareness of that item. As I have argued, the visual system can exploit other kinds of epistemically rewarding causal relationships as well. However, one's ability to be aware of certain things on the basis of their visible context relies ultimately on one's seeing the visible context itself. What one sees is the basis on which one's awareness of non-visible parts of the world rests.

To be clear, the point here is not that one's being phenomenally conscious, rather than unconscious, of the occluding elements depends on being phenomenally conscious of the visible elements. I am not presupposing that visual awareness is necessarily conscious. It is an empirical question whether one can be consciously aware of an occluded part of the scene if one is only unconsciously aware of unoccluded parts (cf. Emmanouil & Ro, 2014; Banica & Schwarzkopf, 2016). The argument here is that one can be in a visual state (conscious or not) that causally depends on and is about a particular occluded part of the scene only if one is in a visual state (conscious or not) that causally depends on and is about suitably related unoccluded parts. I do hold that these visual states are all of types that can be conscious in principle, whether or not they rise to consciousness on a given occasion.

Munton (2021) argues that one can in fact see occluded objects, as when one tracks an object as it passes behind an occluder. But such a view cannot dispense with a distinction between the awareness one has of occluded elements of a scene and the awareness one has of unoccluded elements. This is evident in Munton's discussion of how one can have an experience of an object that has disappeared behind an occluder: "we plausibly need causal contact *at some point* during the extended period of time that has priority in determining the content and character of the moment in question" (Munton, 2021, p. 15). In order to be aware of the object when it is occluded, one must at some point see the object when it was visible. So, to explain our ability to be aware of the object while it is occluded, we must appeal to some narrower notion of *seeing* the object while it is unoccluded.

Of course, one could alternatively distinguish between a broad sense of "seeing," in which one can see an object when it is occluded, and a narrower sense in which one can only see an object when it is visible. To see an object in the broader sense, one must see (or have seen) some part of it in the narrower sense. But this is just a terminological difference from the view I am proposing. Whether we call it "visual awareness" or "seeing in a broad sense," we must distinguish a more restrictive notion of seeing, without which the broader kind cannot get off the ground. This narrower notion constitutes an explanatorily significant kind of visual awareness, on which the broader kind asymmetrically depends. While one can be visually aware of more than what one sees, one cannot be visually aware of anything unless one sees something.

Seeing an item, in the core sense I have in mind here, requires being aware of it on the basis of local cues to that item. To be sure, it is challenging to specify exactly what it is to be a local cue to an item in contrast to a contextual cue. It is not enough to require that a local cue causally depend on the target item. Contextual cues can causally depend on occluded items. There are difficulties with requiring that a local cue to an item depend on light reflected from that item, since we can register local cues to dark, non-reflecting items (see Sorensen, 2008). It cannot be that a cue is local to an item only if that item is a sufficient cause of the cue, independent of its context. Often, local cues consist in a pattern of contrast that depends both on the item and its background. It also cannot be a requirement that each part of the item be involved in producing the local cue. The light reflected by the facing surface of an object plausibly counts as a local cue to the whole object. One possibility is that the distinction between local and contextual cues can take different forms in different causal or explanatory contexts (cf. Phillips, 2015).

It is far from trivial, then, to say what exactly counts as a "local cue," and hence to specify the necessary and sufficient conditions on seeing an item, in the narrow sense that I have been marking out here. In any case, my goal here is not to provide necessary and sufficient conditions on seeing. The central point is that a distinction must be drawn between a broad capacity to be visually aware of parts of the scene, including occluded parts, and a narrower capacity to see parts of the scene that are unoccluded. An adequate explication of what it is to see an item will depend on some distinction between local and contextual cues to that item, no matter how the distinction is ultimately to be precisified. The relation between local and contextual cues explains why visual awareness of anything depends on seeing something. In order to be aware of something on the basis of contextual cues, must be aware of the context on the basis of local cues.

4 | FIXING VISUAL REFERENCE

The distinction between visual awareness and seeing has significant consequences for how these notions are explicated in representational terms. Representational accounts of perception take perceptual capacities to be constituted by abilities to represent parts of the world and their features. A main project of such an account is to explicate notions such as perceiving and seeing in terms of semantic notions such as reference and accuracy. In line with some previous representational accounts of perception, I will treat visual awareness of an item as constituted by successful visual reference to that item. One way to visually refer to something is on the basis of local cues to that thing—that is, seeing the item. However, there are other ways to visually refer to and so be visually aware of items. Successful visual reference to an item is not sufficient for seeing that item. Moreover, seeing does not involve a distinctive mode of reference. Seeing a visible item and being visually aware of a hidden item both involve the same kind of capacity to visually refer. The primary difference is in how reference is fixed. To put it another way, seeing and visual awareness do not differ in the semantic requirements that they place on reference-fixing; rather they differ meta-semantically in the way those requirements happen to be satisfied in a given instance.[9]

The account I sketch here builds on elements that can be found in Burge (2010) (see also Soteriou, 2000; Recanati, 2012, 2013; Schellenberg, 2018). There are compelling reasons, which I will not reproduce here, for taking perceptual experiences to have content in virtue of which they represent the world as being a certain way. An experience is accurate or inaccurate depending on whether the world is the way the experience represents it. The contents of an experience constitutively depend on the contents of visual information-processing states. One's visual experiences and their underlying information-processing states function to have singular *de re* contents. My current experience does not just represent something or other as rectangular; the desk in front of me is such that my visual experience represents *it in particular* as rectangular. For a token perceptual experience to even partially be accurate, there must exist entities such that one's experience is about those entities in particular. The contents of experience therefore involve a primitive kind of reference to objective particulars in the world.

Visual reference is indexical or demonstrative, insofar as the referent of one's experience depends on the situation in which the experience occurs (Pylyshyn, 2003; Burge, 2009; Recanati, 2013). Whether my experience is of this tabletop or some other, qualitatively indistinguishable object, depends on which object is objectively involved in the formation of this very experience. We can therefore characterize the content of my experience, very roughly, by saying that I experience the tabletop as THAT RECTANGULAR SURFACE—more generally, THAT F, for some attribute *F* that I experience the referent as having—rather than as SOME RECTANGULAR SURFACE, say.[10] To be visually aware of an item—for one's experience to be of that item—is for one's visual experience to succeed in referring to that item on that occasion, such that the accuracy of the experience depends on how things are with that item in particular.

One can succeed in being visually aware of, and so visually referring to, particular occluded parts of a scene. The accuracy of the interpolated aspects of my experience depend on the nature

[9] The distinction between "semantics" and "meta-semantics" is adapted here from Kaplan (1989a). Whereas the semantics of perception is concerned with individuating the representational contents of perceptual states, the meta-semantics of perception concerns the underlying factors involved in a perceptual state's having the content that it does.

[10] Nothing hinges here on whether, like Burge, ones takes perception to have a non-propositional attributive content (THAT F) or instead propositional predicative content (THAT IS F).

of the particular occluded parts of the scene that played an objective role (through their influence on their surrounding context) in causing the interpolation. One's experience of the scene depicted in Fig. 1a has as part of its content not just THAT TILTED STRAIGHT CONTOUR ON THE LEFT and THAT TILTED STRAIGHT CONTOUR ON THE RIGHT, but also THAT CURVED CONTOUR IN THE MIDDLE. Successful visual reference to the curved segment is therefore not sufficient for *seeing* that segment. To see an item is not just to succeed in visually referring to it, but to do so partly on the basis of local cues to the item.

Seeing involves one way of fixing visual reference. But does seeing involve a distinctive *mode* or *character* of visual reference? By a representation's "mode of reference," I mean the conditions or requirements that the representation places on successful reference. For example, as a first pass the word "I" invokes the requirement that the referent be the speaker in the relevant context of utterance, while "you" invokes the requirement that the referent be the audience in the context of utterance (Kaplan, 1989b). Different modes of reference correspond to different types of psychological abilities to refer to an item, abilities that function to rely on different kinds of relations to the world in establishing reference. So, the question is whether there is a mode of visual reference, a type of psychological ability, that requires that reference be fixed on the basis of local cues to the referent. The success of this kind of representation would entail that one sees the referent.

One possibility is that there is a type of visual reference that requires reference to be fixed solely on the basis of local cues to the referent. Call this "local-only" reference:

(Local-only) A token visual representation with the content, THAT^{L} F, refers to an item x only if x produced the local stimulations which were the sole basis for tokening the content, THAT^{L} F, on this occasion.[11]

The problem with this proposal is that vision relies pervasively on contextual cues, both in determining which features to attribute to a referent and in securing reference to one item as opposed to another. Even when an object is visible and gives rise to a local feature of the retinal image, contextual cues regularly "enable the image feature to be assigned to an object" (Albright & Stoner, 2002, p. 339). Contextual cues play a normal and pervasive role in helping to secure reference to items that are situated in crowded scenes with many opaque and translucent surfaces, in which some objects are viewed with low resolution in the periphery of one's vision. Local cues are noisy; a local cue to one part of a scene may mix together with a local cue to another part of the scene. Often, however, the causal sources of a given local stimulation can be distinguished by the ways in which they are systematically related to other perceivable parts of the scene. Determinate reference to one causal source often requires jointly referring to these other, related parts of the scene. The reliance on contextual cues is part of the normal functioning of the visual system.

It would be difficult to isolate any normal course of visual processing that functions to be immune to the registration of relevant contextual cues. The contents of a visual state or experience depend on the capacities or abilities that the state or experience exemplifies. If no perceptual capacity functions to exclude contextual inputs, then there is no basis for attributing to a visual state a mode of reference that requires reference be fixed solely on the basis of local cues. So, there are no grounds for postulating a psychological mode of visual reference with a local-only reference-fixing rule.

[11] Note that this only specifies a necessary, not sufficient, condition on fixing reference.

The argument here is an empirical one: there is no perceptual capacity that functions to rely solely on local cues to the exclusion of informative contextual cues. A couple of cases may help to illustrate the way that contextual cues can facilitate the determinate seeing of one item rather than another. I intend these cases to be illustrations of, rather than arguments for, the role of contextual cues in seeing. Consider a modification of a case discussed by Anscombe (1974) and recently taken up by Openshaw & Weksler (2019). Suppose each eye is presented with an image that arises from a distinct, though qualitatively indiscernible, matchbox. Once the two images are binocularly fused, arguably it is either indeterminate to which matchbox one's visual state refers or perhaps the visual state fails to refer at all.

Now suppose the two matchboxes are visibly attached to popsicle sticks of different colors. Since the images of the matchboxes correspond perfectly but their surrounding contexts do not, one would likely experience fusion of the matchboxes but binocular rivalry with respect to the popsicle sticks. When the percept of one popsicle stick is dominant, so that one is visually aware of it, one is thereby in a position to be determinately aware of the particular matchbox to which that stick is attached. It is not even necessary that one accurately perceive the color of the relevant popsicle stick. So long as one's perception is of the one stick and not the other, one will be in a position to be aware of the related matchbox. The visual system relies extensively on structure and redundancy in scenes in order to disambiguate distal sources of information and represent them accurately. The matchbox's attachment to the particular popsicle stick that one experiences can help to anchor reference to that matchbox as opposed to the other. The matchboxes both produce local cues, and so in principle can be seen. But which matchbox one determinately sees depends on contextual cues that arise from related parts of the scene.

As another illustration, suppose you are viewing a thin tinted pane of glass lying on a larger sheet of white paper. Any local stimulation arising from the part of the paper behind the glass will also involve local stimulation arising from the intervening pane of glass. However, you can determinately be aware of the part of the paper behind the glass by registering its relation to the parts of the paper that are not covered up by the glass. If, however, the glass were to cover the paper exactly, it is plausible that the accuracy conditions of your experience would be indeterminate. There would be no clear fact of the matter about which surface is the standard for evaluating the accuracy of the experience. If you experience a medium-gray color, is this experience inaccurate of the white paper or inaccurate of the translucent glass? In general, when a single local stimulation might arise from a mixture of distinct causal sources, the representation of related parts of the scene can play a critical role in determinately fixing reference to a particular one of those sources. What one sees depends not just on the local cues one registers, but also on contextual cues.

Another possibility is that seeing involves a mode of reference that requires at least some local cues to the referent, although contextual cues may play an additional supporting role. According to this "local ± contextual" reference-fixing rule:

(Local ± Context) A token visual representation with the content, THAT$^{L\pm C}$ F, refers to an item x only if x produced local stimulations that were at least partly the basis for tokening the content, THAT$^{L\pm C}$ F, on this occasion.

This mode of visual reference either picks out something that is visible (that produces local cues) or else it fails to represent anything at all. As a consequence, one could not visually refer in this way to a part of the scene while making a mistake about whether that part is visible. However, if one can visually refer to occluded parts at all, as I have argued, then it is conceivable that a visual experience could mistakenly treat an occluded part of the scene as though it were visible without thereby failing to refer to that part. In the "occlusion illusion," the visible part of a figure that is perceived as partly occluded appears larger than a physically identical figure that is not perceived as continuing behind an occluder (Palmer & Schloss, 2017). One explanation of the occlusion illusion is that "the target is perceived as though it were less occluded than it actually is" (Palmer & Schloss, 2009, p. 1083).[12] According to this explanation, the visual system treats an interpolated part of the figure as if it were represented on the basis of local cues to that part, even though the representation in fact draws exclusively on contextual cues.

But while it is illusory to experience an occluded part of an object as if it were a visible part, there is no reason to think it is necessarily a referential illusion. One can plausibly succeed in having an experience of part of an object while making a mistake about whether that part of the object is occluded. We can determinately evaluate whether one's experience of that part's color, shape, size, and position is accurate, even though one misrepresents the part as visible when it is in fact occluded. The accuracy conditions of an experience may well encode commitments about the visibility of the represented item. One's experience might attribute to an item the property of being in front of another opaque surface or the property of being behind another opaque surface (Kellman, 2003). This attribution may be accurate or inaccurate. But to suggest that the visibility of the referent be a requirement on successful *reference* would be to rule out, by fiat, the possibility of perceptual error regarding whether the item one is aware of is occluded or not.

To be sure, alternative explanations of the occlusion illusion are available and there puzzling features of the illusion that I lack space to discuss. Nevertheless, the availability of the explanation mentioned here is enough to cast doubt on any view that entails the impossibility of perceptual error regarding the visibility of a particular item. It is implausible to hold that there is a mode of reference the success of which precludes any mistake about whether the item is occluded or not. Given that one can visually refer to both visible and occluded parts of the scene, it would be surprising if one could not refer to some part of the scene while making a mistake about whether it is occluded.

I propose that both seeing and interpolation involve the same unified semantic mode of reference. Without trying to give anything like an exhaustive characterization of this mode of reference, we can state the relevant requirement as follows:

(Vis Ref) A token visual representation with the content, THAT F, refers to an item x only if the tokening of the content, THAT F, depends on x in an appropriate way.

One "appropriate" way in which the tokening of visual content can depend on an item is via the registration of local stimulus cues from that item. But another appropriate way is for the tokening of the content to depend on the tokening of another content, THAT G, which refers to some other item y that causally depends on x. Visual reference to visible items that one sees does not differ in respect to its semantic requirements from visual reference to occluded items that one does not see. Seeing and visual awareness do not involve semantically distinct modes of reference or requirements on reference-fixing; they differ only meta-semantically with respect to the actual ways in which that requirement is satisfied.

There is a natural analogy here to Quine (1968)'s distinction between "direct" and "deferred" uses of demonstratives (cf. Bermúdez, 2000). In a direct use of a demonstrative, one intends to assert a proposition about the object that is demonstrated (for example, the object pointed at). In

[12] The occlusion illusion differs from the so-called "boundary extension effect" in which a previously displayed object is *remembered* as being less occluded than it actually was (Scherzer & Ekroll, 2015, p. 13).

a deferred use of a demonstrative, one intends to assert a proposition not about the demonstrated object, but about some other object related to the demonstratum. I may utter, "That is my favorite writer," while pointing to a book, thereby intending to assert of the book's author that she is my favorite writer. My arguments above parallel, in a number of respects, Borg (2004)'s arguments for a uniform semantic treatment of both direct and deferred uses of demonstratives. She denies that deferred uses of demonstratives disguise definite descriptions, such as *the author of that book*. Deferred uses of demonstratives play a singular referring role just as standard direct uses do. Further, she argues that there is no distinction in the semantic character or referential requirements of deferred and direct uses of demonstratives: "it is simply not clear that there is anything like a class of special, deferred demonstratives which we can isolate from straightforwardly [direct] demonstratives for a special semantic treatment" (Borg, 2004, p. 179). She concludes, "there are *lots* of ways to draw an object to attention to facilitate the use of a referring expression, and pointing directly to the object is just one way among others—other ways which include pointing at a related object" (Borg, 2004, pp. 179–180). Whatever the right story for demonstratives in language, I suggest that a version of Borg's point holds for vision. There are lots of ways that a visual state can come to refer to part of a scene and the registration of local cues from that part is just one way among others—other ways which include relying on reference to suitably related parts of the scene.[13]

One might have lingering doubts that there is any substance to the question of whether seeing involves a semantically distinctive mode of reference or merely a distinctive way of satisfying a broader mode of reference. But this question has import both for the accuracy conditions of experiences and for the broader question of how to individuate mental representational abilities. As we have seen, a seeing-only mode of reference would preclude the possibility of making a perceptual mistake about whether a particular part of a scene is occluded or not. My proposal allows for cases in which one can succeed in visually referring to an item that seems to be visible, while nevertheless being mistaken about its visibility (whether it is in front of or behind another surface, say). More fundamentally, the question of whether seeing involves a distinctive mode of reference bears on how we individuate mental representational abilities. What I am suggesting is that seeing does not involve the exercise of a distinctive mental ability, separate from the abilities involved in being aware of occluded parts of the world. Rather, what one sees depends on the conditions under which the broader ability to visually refer happens to be exercised.

An important consequence of this account is that seeing cannot be explicated fully in terms of visual reference. There is no mode of visual reference the success of which constitutes seeing. To qualify as seeing something, one must not only succeed in visually referring to it, one must succeed on the basis of certain extra-representational conditions—that is, conditions that are not themselves encoded in the content of one's perceptual representation. Seeing (and perceiving more generally) does not reduce to successful visual (or perceptual) reference.

One might be tempted to draw either of the following lessons from the failure fully to explicate perceiving in terms of successful perceptual reference. On the one hand, one might think that a theory of perceptual representation should be formulated in terms of perceptual reference or awareness while eschewing notions such as seeing and perceiving, which seem to depend on factors that are not marked in perceptual representational contents. This is in line with the view, which I rejected in the previous section, that we adopt a liberal notion of seeing or visual awareness

[13] Borg is more relaxed about the requirements on demonstrative reference in language than I am about the requirements on perceptual reference. Perceptual reference requires that one's perceptual state causally depend, at least in part, on the referent. Still, this causal dependency on one referent may be mediated by a causal dependency on some other referent.

without preserving a narrower notion according to which one can see only what is unoccluded. On the other hand, one might think that a theory of perceiving and seeing can somehow eschew theories of perceptual representation and reference. Both of these reactions should be resisted.

In the first place, while the notion of seeing may not figure into a theory of perceptual representation at the level of specifying *what* the referential contents of perceptual states are, it does correspond to a fundamental way in which such referential contents get fixed. Unless some instances of visual reference are fixed in the way that seeing involves, no referential contents are to be had at all. An account of our perceptual access to particulars must take note of a foundational way in which perceptual awareness or reference is fixed. On the other end of things, while seeing cannot be explicated fully in terms of successful visual reference, the account that I have sketched still explicates seeing in terms of its connection to visual reference. Seeing is visual reference that has been fixed in a special way (on the basis of local cues). This way of fixing reference is not semantically marked in the referential contents of visual perceptual states. But that is not to say that an account of visual contents is irrelevant to understanding the nature of seeing.

The concepts of seeing and of visual awareness, or reference, are both indispensable to an account of how we have perceptual access to particulars in the world, though these concepts belong to different levels of representational explanation. The proposal here occupies a new position in debates about the feasibility of explicating perception in representational terms. If seeing and perceiving cannot be explicated solely in semantic terms, as kinds of representational success, they may nevertheless fit within a broader meta-semantic account of the grounds of representational success.

5 | CONCLUSION

I have argued that capacities for perceptual completion enable one to have visual experiences of particular parts of the world that one cannot see. Psychophysical, neurophysiological, and computational considerations suggest that visual systems encode content specifically about occluded features of the world. These occluded features can be marked in conscious visual experience. In representing and experiencing these features, one can be aware *de re* of particular occluded parts of the scene. One does not just experience some occluded segment or other as having a certain shape; one experiences that very occluded part as having a shape. Visual awareness of occluded parts of the scene is consistent with causal requirements on the objects of visual awareness.

Although one can be visually aware of occluded parts of a scene, I have resisted a move to flatten the notion of "seeing" so as to encompass experiences of things that are not visible. An account of how one comes to be aware of occluded parts of the world must admit a strict sense of seeing, according to which one cannot see what is occluded. This is because the broader capacity to be visually aware of particulars, whether visible or not, depends asymmetrically on the narrower capacity to see parts of the scene that are visible.

The distinction between visual awareness and seeing has fundamental consequences for understanding how our experiences come to be of particular parts of the world. Seeing an item, unlike visual awareness of that item, cannot be explained merely as the successful exercise of a representational ability to visually refer to that particular item. Seeing does not involve a semantically distinctive mode of visual reference. To put it yet another way, no type of visual representation requires that an item be visible in order to be its referent. Still, seeing involves a foundational way in which visual reference gets fixed. Unless one visually refers to something on the basis of local cues, one cannot visually refer to anything. One cannot understand the possibility of successful perceptual representation without considering the conditions that make seeing (and, more generally, perceiving) possible. Conversely, a full account of seeing (perceiving) will have to encompass not just the referential contents of perception but also the *meta-semantic* conditions under which perceptual reference is fixed. Seeing and visual reference are integral, though at different levels of representational explanation, to our perceptual access to particulars in the world.[14]

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REFERENCES

Albright, T. D., & Stoner, G. R. (2002). Contextual influences on visual processing. *Annual Review of Neuroscience*, 25, 339–379. doi: annurev.neuro.25.112701.142900

Anscombe, G. E. M. (1974). Comment on Professor R.L. Gregory's Paper. In S. Brown (Ed.), *Philosophy of Psychology*, (pp. 211–220). Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-02110-9_10

Bach, K. (1987). *Thought and Reference*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198240778.001.0001

Bakin, J. S., Nakayama, K., & Gilbert, C. D. (2000). Visual responses in monkey areas V1 and V2 to three-dimensional surface configurations. *The Journal of Neuroscience*, 20(21), 8188–8198. https://doi.org/10.1523/JNEUROSCI.20-21-08188.2000

Ban, H., Yamamoto, H., Hanakawa, T., Urayama, S., Aso, T., Fukuyama, H., and Ejima, Y. (2013). Topographic representation of an occluded object and the effects of spatiotemporal context in human early visual areas. *The Journal of Neuroscience*, 33(43), 16992–17007. https://doi.org/10.1523/JNEUROSCI.1455-12.2013

Banica, T., & Schwarzkopf, D. S. (2016). Induction of Kanizsa contours requires awareness of the inducing context. *PLoS ONE*, 11(8), e0161177. https://doi.org/10.1371/journal.pone.0161177

Bermúdez, J. L. (2000). Naturalized sense data. *Philosophy and Phenomenological Research*, 61(2), 353. https://doi.org/10.2307/2653655

Borg, E. (2004). *Minimal Semantics*. Oxford: Oxford University Press. https://doi.org/10.1215/00318108-2006-045

Brewer, B. (2011). *Perception and Its Objects*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199260256.001.0001

Briscoe, R. E. (2011). Mental imagery and the varieties of amodal perception. *Pacific Philosophical Quarterly*, 92, 153–173. https://doi.org/10.1111/j.1468-0114.2011.01393.x

Burge, T. (1977). Belief *de re*. *The Journal of Philosophy*, 74(6), 338–362. https://doi.org/10.2307/2025871

Burge, T. (2005). Disjunctivism and perceptual psychology. *Philosophical Topics*, 33(1), 1–78. https://doi.org/10.5840/philtopics20053311

Burge, T. (2009). Five theses on *de re* states and attitudes. In J. Almog, & P. Leonardi (Eds.), *The Philosophy of David Kaplan* (pp. 233–316). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195367881.003.0015

Burge, T. (2010). *Origins of Objectivity*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199581405.001.0001

Campbell, J. (2002). *Reference and Consciousness*. Oxford: Oxford University Press. https://doi.org/10.1093/0199243816.001.0001

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Carrigan, S. B., Palmer, E. M., & Kellman, P. J. (2016). Differentiating global and local contour completion using a dot localization paradigm. *Journal of Experimental Psychology: Human Perception and Performance*, 42(12), 1928–1946. https://doi.org/10.1037/xhp0000233

Child, W. (1992). Vision and experience: The causal theory and the disjunctive conception. *The Philosophical Quarterly*, 42(168), 297–316. https://doi.org/10.2307/2219682

de Wit, T. C. J., Vrins, S., Dejonckheere, P. J. N., & vanLier, R. (2008). Form perception of partly occluded shapes in 4-month-old infants. *Infancy*, 13(6), 660–674. https://doi.org/10.1080/15250000802458864

Dickie, I. (2011). Visual attention fixes demonstrative reference by eliminating referential luck. In C. Mole, D. Smithies, & W. Wu, (Eds.), *Attention: Philosophical and Psychological Essays* (pp. 292–322). Oxford University Press.

Dretske, F. I. (1969). *Seeing and Knowing*. London: Routledge & Kegan Paul. https://doi.org/10.2307/2217582

Elder, J. H., & Goldberg, R. M. (2002). Ecological statistics of Gestalt laws for the perceptual organization of contours. *Journal of Vision*, 2(4), 324–353. https://doi.org/10.2307/2217582

Emmanouil, T. A., & Ro, T. (2014). Amodal completion of unconsciously presented objects. *Psychonomic Bulletin & Review*, 21(5), 1188–1194. https://doi.org/10.3758/s13423-014-0590-9

Evans, G. (1982). *The Varieties of Reference*. Oxford: Oxford University Press.

Fantoni, C., & Gerbino, W. (2003). Contour interpolation by vector-field combination. *Journal of Vision*, 3(4), 281–303. https://doi.org/10.1167/3.4.4

Fantoni, C., Hilger, J. D., Gerbino, W., & Kellman, P. J. (2008). Surface interpolation and 3d relatability. *Journal of Vision*, 8(7), 29. https://doi.org/10.1167/8.7.29

Fulvio, J. M., Singh, M., & Maloney, L. T. (2008). Precision and consistency of contour interpolation. *Vision Research*, 48(6), 831–849. https://doi.org/10.1016/j.visres.2007.12.018

Ganson, T. (2020). An alternative to the causal theory of perception. *Australasian Journal of Philosophy*, 99(4), 683–695. https://doi.org/10.1080/00048402.2020.1836008

Geisler, W. S., Perry, J., Super, B., & Gallogly, D. (2001). Edge co-occurrence in natural images predicts contour grouping performance. *Vision Research*, 41(6), 711–724. https://doi.org/10.1016/s0042-6989(00)00277-7

Geisler, W. S., & Perry, J. S. (2009). Contour statistics in natural images: Grouping across occlusions. *Visual Neuroscience*, 26(1), 109–121. https://doi.org/10.1017/s0952523808080875

Gibson, J. J. (1966). *The Senses Considered as Perceptual Systems*. Boston: Houghton Mifflin.

Gold, J. M., Murray, R. F., Bennett, P. J., & Sekuler, A. B. (2000). Deriving behavioural receptive fields for visually completed contours. *Current Biology*, 10(11), 663–666. https://doi.org/10.1016/s0960-9822(00)00523-6

Goldman, A. (1977). Perceptual objects. *Synthese*, 35(3), 257–284. https://doi.org/10.1007/bf00485548

Green, E. (2017). Attentive visual reference. *Mind & Language*, 32(1), 3–38. https://doi.org/10.1111/mila.12131

Green, E. (2018). A theory of perceptual objects. *Philosophy and Phenomenological Research*, 99(3), 663–693. https://doi.org/10.1111/phpr.12521

Grice, H. (1961). The causal theory of perception. *Proceedings of the Aristotelian Society, Supplementary Volumes*, 35, 121–152. https://doi.org/10.1093/aristoteliansupp/35.1.121

Guttman, S. E., & Kellman, P. J. (2004). Contour interpolation revealed by a dot localization paradigm. *Vision Research*, 44(15), 1799–1815. https://doi.org/10.1016/j.visres.2004.02.008

R. Jeshion, (Ed.) (2010). *New Essays on Singular Thought*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199567881.001.0001

Kalar, D. J., Garrigan, P., Wickens, T. D., Hilger, J. D., & Kellman, P. J. (2010). A unified model of illusory and occluded contour interpolation. *Vision Research*, 50, 284–299. https://doi.org/10.1016/j.visres.2009.10.011

Kaplan, D. (1989a). Afterthoughts. In J. Almog, J. Perry, & H. Wettstein (Eds.), *Themes from Kaplan* (pp. 565–614). New York: Oxford University Press.

Kaplan, D. (1989b). Demonstratives. In J. Almog, J. Perry, & H. Wettstein, (Eds.), *Themes from Kaplan* (pp. 481–563). New York: Oxford University Press.

Keane, B. P. (2018). Contour interpolation: A case study in modularity of mind. *Cognition*, 174, 1–18. https://doi.org/10.1016/j.cognition.2018.01.008

Keane, B. P., Lu, H., & Kellman, P. J. (2007). Classification images reveal spatiotemporal contour interpolation. *Vision Research*, 47(28), 3460–3475. https://doi.org/10.1016/j.visres.2007.10.003

Keane, B. P., Lu, H., Papathomas, T. V., Silverstein, S. M., & Kellman, P. J. (2012). Is interpolation cognitively encapsulated? measuring the effects of belief on Kanizsa shape discrimination and illusory contour formation. *Cognition*, 123(3), 404–418. https://doi.org/10.1016/j.cognition.2012.02.004

Kellman, P. J. (2001). Separating processes in object perception. *Journal of Experimental Child Psychology*, 78(1), 84–97. https://doi.org/10.1006/jecp.2000.2604

Kellman, P. J. (2003). Interpolation processes in the visual perception of objects. *Neural Networks*, 16, 915–923. https://doi.org/10.1016/S0893-6080(03)00101-1

Kellman, P. J., Garrigan, P., & Erlikhman, G. (2013). Challenges in understanding visual shape perception and representation: Bridging subsymbolic and symbolic coding. In S. Dickinson & Z. Pizlo (Eds.), *Shape Perception in Human and Computer Vision: An Interdisciplinary Perspective* (pp. 249–274). London: Springer-Verlag. https://doi.org/10.1007/978-1-4471-5195-1_18

Kellman, P. J., Garrigan, P., & Shipley, T. F. (2005). Object interpolation in three dimensions. *Psychological Review*, 112(3), 586–609. https://doi.org/10.1037/0033-295x.112.3.586

Kellman, P. J., & Shipley, T. F. (1991). A theory of visual interpolation in object perception. *Cognitive Psychology*, 23(2), 141–221. https://doi.org/10.1016/0010-0285(91)90009-d

Kellman, P. J., & Spelke, E. S. (1983). Perception of partly occluded objects in infancy. *Cognitive Psychology*, 15(4), 483–524. https://doi.org/10.1016/0010-0285(83)90017-8

Kellman, P. J., Yin, C., & Shipley, T. (1998). A common mechanism for illusory and occluded object completion. *Journal of Experimental Psychology: Human Perception and Performance*, 24(3), 859–869. https://doi.org/10.1016/0010-0285(83)90017-8

Logue, H. (2012). Why naive realism? *Proceedings of the Aristotelian Society*, 112(2pt2):211–237. https://doi.org/10.1111/j.1467-9264.2012.00332.x

Martin, M. (2002). Particular thoughts & singular thought. *Royal Institute of Philosophy Supplement*, 51, 173–214. https://doi.org/10.1017/s1358246100008134

Martin, M. (2006). On being alienated. In T. S. Gendler & J. Hawthorne (Eds.), *Perceptual Experience* (pp. 354–410). Oxford: Oxford University Press.

Matthen, M. (2019). Objects, seeing, and object-seeing. Synthese. https://doi.org/10.1007/s11229-019-02279-6

Munton, J. (2021). How to see invisible objects. *Noûs*. https://doi.org/10.1111/nous.12360

Murray, M. M., Foxe, D. M., Javitt, D. C., & Foxe, J. J. (2004). Setting boundaries: Brain dynamics of modal and amodal illusory shape completion in humans. *The Journal of Neuroscience*, 24(31), 6898–6903. https://doi.org/10.1523/JNEUROSCI.1996-04.2004

Nakayama, K., He, Z. J., & Shimojo, S. (1995). Visual surface representation: A critical link between lower-level and higher-level vision. In S. Kosslyn & D. Osherson (Eds.), *Invitation to Cognitive Science*, (Vol. 2, pp. 1–70). Cambridge, MA: MIT Press.

Nanay, B. (2010). Perception and imagination: Amodal perception as mental imagery. *Philosophical Studies*, 150(2), 239–254. https://doi.org/10.1007/s11098-009-9407-5

Nanay, B. (2018). The importance of amodal completion in everyday perception. *i-Perception*, 9(4), 1–16. https://doi.org/10.1177/2041669518788887

Openshaw, J. & Weksler, A. (2019). A puzzle about seeing for representationalism. Philosophical Studies (pp. 1–22). https://doi.org/10.1007/s11098-019-01331-y

Palmer, E., Kellman, P., & Shipley, T. (2006). A theory of dynamic occluded and illusory object perception. *Journal of Experimental Psychology: General*, 135(4), 513–541. https://doi.org/10.1037/0096-3445.135.4.513

Palmer, S. E., & Schloss, K. B. (2009). Stereoscopic depth and the occlusion illusion. *Attention, Perception, & Psychophysics*, 71(5), 1083–1094. https://doi.org/10.3758/app.71.5.1083

Palmer, S. E., & Schloss, K. B. (2017). The occlusion, configural shape, and shrinkage illusions. In A. G. Shapiro, & D. Todorović, (Eds.), *The Oxford Compendium of Visual Illusions* (pp. 269–274). Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199794607.003.0029

Pasupathy, A., El-Shamayleh, Y. & Popovkina, D. V. (2018). Visual shape and object perception. In Oxford Research Encyclopedia of Neuroscience. http://neuroscience.oxfordre.com/view/10.1093/acrefore/9780190264086.001.0001/acrefore-9780190264086-e-75.

Pessoa, L., Thompson, E., & Noë, A. (1998). Finding out about filling-in: A guide to perceptual completion for visual science and the philosophy of perception. *Behavioral and Brain Sciences*, 21(6), 723–748. https://doi.org/10.1017/s0140525x98001757

Phillips, B. (2015). Contextualism about object-seeing. *Philosophical Studies*, 173(9), 2377–2396. https://doi.org/10.1007/s11098-015-0619-6

Pylyshyn, Z. (2003). *Seeing and Visualizing: It's Not What You Think*. Cambridge, MA: The MIT Press. https://doi.org/10.7551/mitpress/6137.001.0001

Quine, W. V. (1968). Ontological relativity. *Journal of Philosophy*, 65(7), 185–212. https://doi.org/10.2307/2024305

Recanati, F. (2012). *Mental Files*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199659982.001.0001

Recanati, F. (2013). Perceptual concepts: In defence of the indexical model. *Synthese*, 190(10), 1841–1855. https://doi.org/10.1007/s11229-013-0264-6

Ringach, D. L., & Shapley, R. (1996). Spatial and temporal properties of illusory contours and amodal boundary completion. *Vision Research*, 36(19), 3037–3050. https://doi.org/10.1016/0042-6989(96)00062-4

Rubin, N. (2001). The role of junctions in surface completion and contour matching. *Perception*, 30(3), 339–366. https://doi.org/10.1068/p3173

Schellenberg, S. (2018). *The Unity of Perception: Content, Consciousness, Evidence*. Oxford: Oxford University Press. https://doi.org/10.1093/oso/9780198827702.001.0001

Scherzer, T. R., & Ekroll, V. (2015). Partial modal completion under occlusion: What do modal and amodal percepts represent? *Journal of Vision*, 15(1), 1–20. doi:10.1167/15.1.22

Shipley, T. F., & Cunningham, D. W. (2001). Perception of occluding and occluded objects over time: Spatiotemporal segmentation and unit formation. In T. Shipley, & P. Kellman, (Eds.), *From Fragments to Objects: Segmentation and Grouping in Vision* (pp. 557–585). New York: Elsevier Science Publishers B.V.

Siegel, S. (2006). How does visual phenomenology constrain object-seeing? *Australasian Journal of Philosophy*, 84(3), 429–441. https://doi.org/10.1080/00048400600895961

Siegel, S. (2010). *The Contents of Visual Experience*. New York: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195305296.001.0001

Smith, J. (2010). Seeing other people. *Philosophy and Phenomenological Research*, 81(3), 731–748. https://doi.org/10.1111/j.1933-1592.2010.00392.x

Smithies, D. (2013). The nature of cognitive phenomenology. *Philosophy Compass*, 8(8), 744–754. https://doi.org/10.1111/phc3.12053

Sorensen, R. (2008). *Seeing Dark Things: The Philosophy of Shadows*. Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195326574.001.0001

Soteriou, M. (2000). The particularity of visual perception. *European Journal of Philosophy*, 8(2), 173–189. https://doi.org/10.1111/1468-0378.00107

Strawson, P. (1959). *Individuals: An Essay in Descriptive Metaphysics*. London: Routledge. https://doi.org/10.4324/9780203221303

Strawson, P. (1979). Perception and its objects. In G. Macdonald (Ed.), *Perception and Identity: Essays Presented to A.J. Ayer with his Replies to Them* (pp. 41–60). New York: Macmillan Press Ltd.

Sugita, Y. (1999). Grouping of image fragments in primary visual cortex. *Nature*, 401, 269–272. https://doi.org/10.1038/45785

Takeichi, H., Nakazawa, H., Murakami, I., & Shimojo, S. (1995). The theory of the curvature-constraint line for amodal completion. *Perception*, 24(4), 373–389. https://doi.org/10.1068/p240373

Thielen, J., Bosch, S. E., van Leeuwen, T. M., van Gerven, M. A. J., & van Lier, R. (2019). Neuroimaging findings on amodal completion: A review. *i-Perception*, 10(2), 204166951984004. https://doi.org/10.1177/2041669519840047

van Lier, R. (1999). Investigating global effects in visual occlusion: From a partly occluded square to the back of a tree-trunk. *Acta Psychologica*, 102(2–3), 203–220. https://doi.org/10.1016/S0001-6918(98)00055-9

van Lier, R., & Gerbino, W. (2015). Perceptual completions. In J. Wagemans (Ed.), *The Oxford Handbook of Perceptual Organization* (pp. 294–320). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199686858.013.040

Yun, X., Hazenberg, S. J., & van Lier, R. (2018). Temporal properties of amodal completion: Influences of knowledge. *Vision Research*, 145, 21–30. https://doi.org/10.1016/j.visres.2018.02.011

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