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Spatial perception: The perspectival aspect of perception

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Abstract

When we perceive an object, we perceive the object from a perspective. As a consequence of the perspectival nature of perception, when we perceive, say, a circular coin from different angles, there is a respect in which the coin looks circular throughout, but also a respect in which the coin's appearance changes. More generally, perception of shape and size properties has both a constant aspect—an aspect that remains stable across changes in perspective—and a perspectival aspect—an aspect that changes depending on one's perspective on the object. How should we account for the perspectival aspect of spatial perception? We present a framework within which to discuss the perspectival aspect of perception and put forward three desiderata that any account of the perspectival aspect of perception should satisfy. We discuss views on which the perspectival aspect of perception is analyzed in terms of constitutively mind-dependent appearance properties as well as views on which the perspectival aspect of perception is analyzed in terms of representations of mind-independent perspectival properties.

1 | INTRODUCTION

When we perceive objects, we perceive them as having a multitude of spatial properties, including size, shape, and location. While the study of spatial perception has a distinguished history in philosophy, the topic has received relatively little recent attention compared with, say, the perception of color. This entry should help rectify this state of affairs. We will focus on a specific question about spatial perception, namely, the question of how to account for the perspectival aspect of perception.

When we perceive an object, we perceive the object from a perspective. As a consequence, when we perceive a circular coin from different angles, there is a respect in which the coin looks circular throughout, but also a respect in which the coin's appearance changes. Likewise, when we perceive two trees of the same size located at different distances from us, there is a respect in which they look the same size, but also a respect in which they appear different (e.g., Cohen, 2010; Peacocke, 1983; Schellenberg, 2008). More generally, perception of shape and size properties has

both a *constant* aspect—an aspect that remains stable across changes in perspective—and a *perspectival* aspect—an aspect that changes depending on one's perspective on the object. How should we account for the perspectival aspect of spatial perception?

In Section 2, we present a framework within which to discuss the perspectival aspect of perception. In Section 3, we put forward three desiderata that any account of the perspectival aspect of perception should satisfy. In Section 4, we consider views on which the perspectival aspect of perception is analyzed in terms of constitutively mind-dependent appearance properties. In Section 5, we discuss views on which the perspectival aspect of perception is analyzed in terms of representations of mind-independent perspectival properties. Since the literature on spatial perception has focused primarily on visual perception, we will be doing the same here. However, for recent discussions of spatial perception in audition, see for example Casati and Dokic (2009) and O'Callaghan (2010).

2 | PERSPECTIVAL PROPERTIES, APPEARANCE PROPERTIES, INTRINSIC PROPERTIES, AND CONSTANCY PROPERTIES

To critically discuss different ways of accounting for the perspectival aspect of perception, it will be helpful to distinguish two kinds of properties in connection with both the perspectival aspect and the constant aspect of perceptual experience.

Let's start with the perspectival aspect. There are external, mind-independent properties that change as a perceiver's location in relation to a perceived object changes ceteris paribus. We will call these *mind-independent perspectival properties* or *perspectival properties* for short. In Section 5, we will distinguish several ways of analyzing these perspectival properties. For now, it will suffice to say that they are mind-independent relational properties that we can be aware of when we perceive our environment. Note that perspectival properties involve relations to a perceiver's *location* rather than relations to the perceiver or to her experience. Thus, such properties are mind-independent relational properties, because they do not constitutively involve anything mental. We can contrast these external, mind-independent properties from properties of perceptual experience that change as a perceiver's location in relation to a perceived object changes ceteris paribus. We will call these *mind-dependent appearance properties* or *appearance properties* for short. Since appearance properties are properties of the perceiver's experience, they are mind-dependent. However, it is possible that such mind-dependent properties may be understood in terms of the perceiver's awareness of certain mind-independent properties—namely, perspectival properties. By analogy, the property of being speckled is a mind-independent property but the property of being aware of speckledness is a mind-dependent property.

In Section 4, we will discuss views on which appearance properties are not analyzed in terms of awareness of mind-independent perspectival properties but are rather analyzed as either monadic mind-dependent properties or alternatively in terms of awareness of mind-dependent entities, such as phenomenal properties. On both approaches, appearance properties are mind-dependent all the way down. In Section 5, we will discuss views on which appearance properties are analyzed in terms of awareness of perspectival properties. Changes in perspectival properties include changes in an object's distance and orientation with respect to the perceiver's location. Changes in appearance properties include changes in phenomenal character and perhaps also perceptual representation.

A distinction parallel to the distinction between perspectival properties and appearance properties can be made with regard to the constant aspect of perceptual experience. There are external, mind-independent properties that remain the same as a perceiver's location in relation to a perceived object changes ceteris paribus. We will call these *mind-independent intrinsic properties* or *intrinsic properties* for short. We can contrast these external, mind-independent properties from properties of perceptual experience that remain the same as a perceiver's location in relation to a perceived object changes ceteris paribus. We will call these *mind-dependent constancy properties* or *constancy properties* for short.[1]

To focus the discussion, it will help to have a specific example in mind. Consider Sam. At time t1, Sam sees a box from directly above (Figure 1.). Let's call this View 1. At time t2, he sees the same box from a different angle (Figure 1b). Let's call this View 2. There is a sense in which the top of the box looks rectangular in both View 1 and View 2, but there is also a sense in which it looks different in Views 1 and 2. Some might say that in View 2, the surface looks trapezoidal, though many will disagree with this description of the phenomenal character of seeing a slanted box (Schellenberg, 2008).[2] The box's intrinsic properties remain the same, while its perspectival properties differ in Views 1 and 2 relative to Sam's location. For example, the box's orientation relative to Sam's line of sight changes, but its top remains rectangular. Sam's experience instantiates the same constancy property but different appearance properties in Views 1 and 2. This is the sense in which the box both "looks different" and "looks the same" between the two views.

The distinctions between perspectival and intrinsic properties as well as between appearance and constancy properties allow us to formulate the following questions for any view of the perspectival aspect of spatial perception. How should we understand the nature of perspectival properties? How should we understand the nature of appearance properties? What is the relationship between perspectival properties and appearance properties? What is the relationship between intrinsic properties and constancy properties? Finally, what is the relationship between appearance properties and constancy properties?

3 | THREE DESIDERATA FOR AN ACCOUNT OF PERSPECTIVAL VARIATION

With the distinction among perspectival properties, appearance properties, intrinsic properties, and constancy properties in hand, we can formulate three desiderata for any account of the perspectival aspect of spatial perception:

Dual Aspect Desideratum: Perceptual experience is characterized by both appearance properties and constancy properties, and these properties at least partially account for the phenomenal character of spatial perception.

This desideratum captures the idea that when Sam perceives the box first in View 1 and then in View 2, there is a sense in which the top surface of the box looks the same in both views and there is a sense in which it looks different

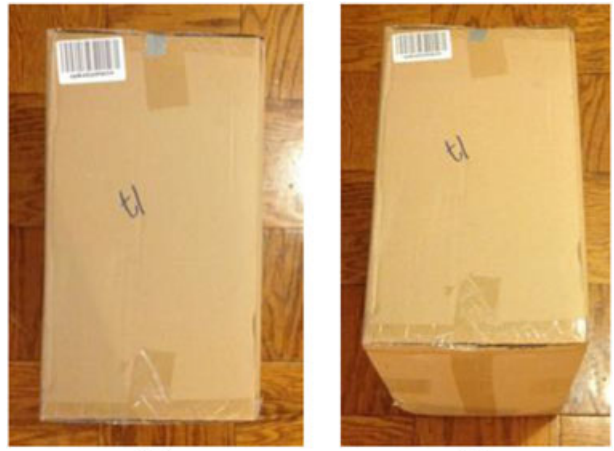

FIGURE 1 View 1 (a) and View 2 (b) of the box

in View 1 than it does in View 2. In both views, Sam's experience is characterized by the same constancy property; however, the two experiences have different appearance properties. Note that a constancy property is a property of a single experience, but multiple experiences can be characterized by the same constancy property. Of course not all experiences instantiate the same constancy properties. For example, if Sam views a trapezpoidal surface from directly above, then his experience will fail to instantiate the constancy property instantiated by his experiences of the rectangular surface. A viable account of the perspectival aspect of perception should explain these features of Sam's experience.

Consistency Desideratum: The perceptual content of subject's perceptual experience is not inconsistent as a consequence of the subject perceiving an external, mind-independent object from a perspective. This is the case even if perceptual content grounds both an appearance property and a constancy property with regard to the same perceived object.

Let's assume for the sake of argument that the box perceived in View 2 looks trapezoidal to Sam. A view that satisfies the consistency desideratum will be a view on which Sam's perceptual content is consistent despite the fact that it grounds both the box looking trapezoidal and the box looking rectangular. On non-representationalist views of perceptual experience, the consistency desideratum needs to be reformulated in non-representationalist terms.[3] On such views, the reformulated consistency desideratum is satisfied if the fact that the box looks trapezoidal to Sam in View 2 is not inconsistent with the fact the box looks rectangular to Sam. Either way, the consistency desideratum accounts for the fact that the appearance and constancy aspects of one's perceptual experience are not incompatible with one another.

Perspective without Illusion Desideratum: If a subject's perceptual experience is characterized by an appearance property, this does not entail that the experience is illusory.

The top of the box is in fact rectangular. However, if there is a sense in which it looks trapezoidal when perceived at a slant, this does not entail that it is being misperceived. If we assume that we perceive perspectival properties, then accounting for the perspective without illusion desideratum will require showing that the fact that we perceive perspectival properties does not entail that perception is illusory.

In what follows, we will discuss a range of views of the perspectival aspect of spatial perception, examine whether and how they satisfy these three desiderata, and discuss some problems facing each view. First, we will discuss views that account for the perspectival aspect of spatial perception in constitutively mind-dependent ways. We will then discuss views that account for the perspectival aspect of spatial perception in terms of awareness of mind-independent perspectival properties.

4 | SENSE DATA AND SENSATIONS

On all the views we will consider, the perspectival aspect of spatial perception is understood in terms of appearance properties. However, we can distinguish views that analyze such appearance properties in terms of the awareness of mind-independent perspectival properties from views that instead analyze appearance properties in constitutively mind-dependent ways. In this section, we will consider views on which the perspectival aspect of spatial perception is analyzed in constitutively mind-dependent ways. There are two such approaches. On one approach, appearance properties are analyzed in terms of awareness of mind-dependent objects or properties. On a second approach, appearance properties are treated as primitive to perceptual experience rather than as properties to be analyzed in terms of awareness of something else, be it a mind-dependent or a mind-independent property (such as a perspectival property).

4.1 | Sense data

Some have proposed that when Sam sees the box in View 2, he is aware of a mind-dependent object—e.g., a sense datum or an image—that is in fact trapezoidal (e.g., Ayer 1963; Broad, 1925; Robinson, 1994; Russell, 1912).[4] On this type of view, shape and size appearance properties are analyzed in terms of awareness of intrinsic properties of sense data. This view has its root in the British Empiricist notion of an idea (Hume, 1758/2007; Locke, 1690/1975). As it is developed by sense data theorists, we infer information about the intrinsic shapes and sizes of external physical objects (e.g., the rectangularity of the top of the box) from our immediate awareness of the shapes and sizes of sense data.

The sense datum view satisfies the perspective without illusion desideratum. After all, sense data actually have the shapes and sizes of which we are putatively aware. The sense datum you are aware of when viewing the box at a slant really is trapezoidal. Thus, you are not under an illusion when you perceive it as trapezoidal.

Moreover the sense datum view satisfies the consistency desideratum for two reasons. First, many sense datum theorists hold that the property of rectangularity does not in fact figure in one's perceptual experience of the box at all but rather is inferred on the basis of awareness of the properties of sense data. Thus, there can be no contradiction internal to experience between the properties trapezoidal and rectangular. Second, there is no contradiction between perception and perceptual judgment, because the properties trapezoidal and rectangular are attributed to different things. The former is attributed to a sense datum, while the latter is attributed (in judgment) to an external object.

Matters are less clear for the sense datum view when it comes to the dual aspect desideratum. Arguably when Sam sees the box in View 2, he does not merely judge or infer that the box is rectangular. He experiences it as such.[5] This is what we have meant by the claim that perceptual experience instantiates constancy properties. However, on standard versions of the sense datum view, Sam is not perceptually aware of the rectangularity of the box, but rather judges that the box is rectangular (Ayer 1963; Broad, 1925). The theory holds that the properties of which Sam is perceptually aware when he views the slanted box are properties of a trapezoidal sense datum that the box elicits. But this sense datum cannot be both rectangular and trapezoidal. Thus, this version of the sense datum view does not satisfy the dual aspect desideratum.

While the sense datum theory has been rejected on such grounds (e.g., Noë, 2005), the sense datum theorist could in principle satisfy the dual aspect desideratum by positing that there are both sense data corresponding to certain perspectival properties and sense data corresponding to intrinsic properties. For example, one might hold that when viewing a slanted box, we are aware of two separate sense data: A rectangular sense datum and a trapezoidal sense datum, where the latter is supposed to correspond to some perspectival property of the box. Indeed, a sophisticated version of sense datum theory might hold that there are sense data corresponding to intrinsic properties, but also sense data corresponding to one or more of the mind-independent perspectival properties that we'll consider in Section 5.

The main reasons for rejecting the sense datum view are independent of satisfying our three desiderata. One central problem concerns where sense data are located (see, e.g., Huemer, 2001: 149–168). If they are located in physical space, then why can we not detect them by means of standard scientific instruments? If they are not located in physical space, then how do we interact with or become sensorily aware of them? A further problem is that standard versions of sense datum view are committed to mind-body dualism and this view faces familiar difficulties that we will not rehash here.[6]

4.2 | Sensations

A different approach to accounting for the perspectival aspect of perception is to argue that perceptual experience is characterized by sensations in addition to representing intrinsic properties (Peacocke, 1983; 2008). Consider again Sam, who sees the slanted box (View 2) and represents the box's intrinsic shape as rectangular. The sensations account posits that Sam's experience is characterized by a sensation or sensational property that accounts for the

trapezoidal appearance of the box. In this way, the "trapezoidal" aspect of the experience is explained by appeal to mind-dependent, non-representational sensational properties, while the "rectangular" aspect is explained by appeal to how the experience represents the box.[7]

Since the sensation is a property of one's experience and the intrinsic property represented is a property of the external object, the two cannot conflict. After all, sensations are not perceptually represented. Since sensations are not part of perceptual content, they cannot be accurate or inaccurate and also cannot give rise to contradiction with regard to the properties represented by experience. Thus, if appearance properties are accounted for in terms of sensations while constancy properties are accounted for in terms of representations of intrinsic shape, the consistency desideratum is satisfied. Moreover, assuming that sensations do not make perceptual phenomenology illusory, the perspective without illusion desideratum is satisfied.

Proponents of the sensation account have a variety of options for understanding the relation between sensational properties and representational properties. One approach is to treat them as wholly separate. However, a different version of the sensation view would hold that phenomenal visual sensations are the *means* through which we represent physical spatial properties. Hatfield (2009: ch. 6; 2016), for instance, holds that a slanted rectangular surface causes a trapezoidal phenomenal visual appearance, and that this appearance is the way that we represent the surface's rectangularity from our perspective. He also holds that physically parallel lines receding into the distance elicit a phenomenal visual appearance in which the lines converge, and that this is the way that receding parallel lines are represented in perception.

Many philosophers have rejected the sensation view because they believe that it fits poorly with the phenomenal character of spatial perception and, thus, has problems satisfying the dual aspect desideratum. Harman (1990), for example, has argued that when we introspect our visual experience, it seems to us as though the properties of which we are aware are properties of external, mind-independent objects rather than intrinsic features of our experience. This is standardly referred to as the transparency thesis. If the transparency thesis is true, then when Sam perceives the box first in View 1 and then in View 2, the change that he is aware of will seem to him to be a change in the box, or in his relation to it, rather than an intrinsic change to his experience of the box. Those attracted to the transparency thesis have thus argued that appearance properties should be analyzed in terms of awareness of external perspectival properties rather than in terms of intrinsic features of experience (Hill, 2014: 212; Tye, 2002).

Moreover, there are properties of the box that change when Sam sees the box first in View 1 and then in View 2, namely, properties that the box has in virtue of its relation to Sam's viewpoint. The sensations approach accounts for the difference in Sam's experience between these views in terms of properties that are entirely mind-dependent. However, note that any perceiver occupying Sam's location would undergo a similar change in appearance properties, and there are mind-independent properties of the box that change between View 1 and View 2. One might argue that these facts are reason enough to analyze the change in Sam's experience in terms of awareness of mind-independent properties.[8] There are constitutive regularities both between intrinsic properties and relevant constancy properties as well as between perspectival properties and relevant appearance properties. By treating appearance properties as entirely independent of awareness of perspectival properties, the sensations view does not account for these regularities.

5 | APPEARANCE PROPERTIES AS AWARENESS OF MIND-INDEPENDENT PROPERTIES

An alternative to treating appearance properties as constitutively mind-dependent is to analyze appearance properties in terms of awareness of mind-independent perspectival properties. On such views, the changes in Sam's spatial experience as he adopts different viewpoints with respect to the box are analyzed in terms of his awareness of changes in properties the box has relative to his viewpoint (e.g., Hill, 2014; Schellenberg, 2008; Tye, 2002). While appearance properties are analyzed in terms of awareness of perspectival properties, constancy properties are

analyzed in terms of awareness of intrinsic properties. On this cluster of views, the focus is on the nature of perspectival properties. To a first approximation, the perspectival properties of an object are determined by the object's intrinsic properties and the perceiver's location. Beyond this general characterization, there are several different ways of analyzing perspectival properties. We will consider them in turn.

5.1 | Aspects

One way to account for the perspectival aspect of perception in terms of mind-independent properties builds on the basic observation that from different viewpoints, different portions of an object's surface become visible (where "*x* is visible" means something like "*x* supplies light to the retinas"). For instance, when you view a solid cube, at any given time at most three of its faces will be visible, while the others will be occluded. Changes in viewpoint will bring some of the faces that were previously hidden into view and hide some faces that were previously visible. More generally, suppose that one occupies a particular viewpoint *v* with respect to a polyhedral object *o*. From *v*, a particular configuration of o's edges and vertices will be visible. This configuration, along with the topological relations between the edges, is called an aspect of o. The collection of o's aspects constitutes its view potential (see Koenderink, 1984; Palmer, 1999: 446–447; Tarr & Kriegman, 2001; for recent philosophical discussions of aspects, see Briscoe, 2008; Noë, 2004). If the same set of edges and vertices is visible from two distinct viewpoints, then the same aspect of *o* is visible from those two viewpoints. If a different set of edges and vertices is visible from two distinct viewpoints, then a different aspect of *o* is visible from those two viewpoints.

Aspects are a kind of perspectival property. On the aspect account, appearance properties can be analyzed in terms of the awareness of aspects. We will assume that constancy properties are analyzed in terms of awareness of intrinsic properties. How does the aspect account fare with respect to our three desiderata? Assuming we are aware of both an object's aspect and its intrinsic spatial properties, the view satisfies the dual aspect desideratum.[9] It satisfies the consistency desideratum since an object's intrinsic shape and an object's aspect given a perspective are two different things, and so, an experience in which one represents or is aware of both will not be inconsistent. The view satisfies the perspective without illusion desideratum: Since an object really does make different aspects visible to different viewpoints, there is no illusion involved in being perceptually aware of different aspects from different viewpoints.

However, it is questionable whether the appeal to aspects can provide a complete account of the perspectival aspect of perception. Aspects are simply too coarse-grained to explain what makes rectangular surfaces at a slant "look trapezoidal" (if in fact they do look that way). Thus, consider View 3 of the box (Figure 2), from a perspective intermediate between Views 1 and 2. In whatever sense in which the top of the box looks trapezoidal in View 2, it arguably also looks trapezoidal in View 3. However, Views 1 and 3 are associated with the same aspect of the object, since the same configuration of edges and vertices is visible.

Thus, even if appeal to aspects supplies a partial explanation of the perspectival aspect of spatial perception, it is unlikely to be the whole story. Aspects do not provide much by way of insight into the types of changes in appearance properties that have generally occupied philosophers, for they do not explain why slanted objects look "compressed," or, for that matter, why far away objects look "smaller." Moreover, while there is clearly a difference between the aspects of an object that are directly visibly available to one and those that are not, arguably, we perceive three-dimensional objects as having back sides, and we perceive their shapes as being continuous even if the whole shape is not directly visibly available to one.

5.2 | P-shapes and solid visual angles

An alternative approach to analyzing appearance properties in terms of awareness of mind-independent perspectival properties involves direct appeal to the two-dimensional projection of an object either onto the retina (e.g., Lowe, 1992: 87–88) or onto the frontal plane, that is, a plane perpendicular to the line of sight leading from one's viewpoint to the object (Noë, 2004, 2005). Following Noë, we will refer to the shape of an object's projection onto the frontal

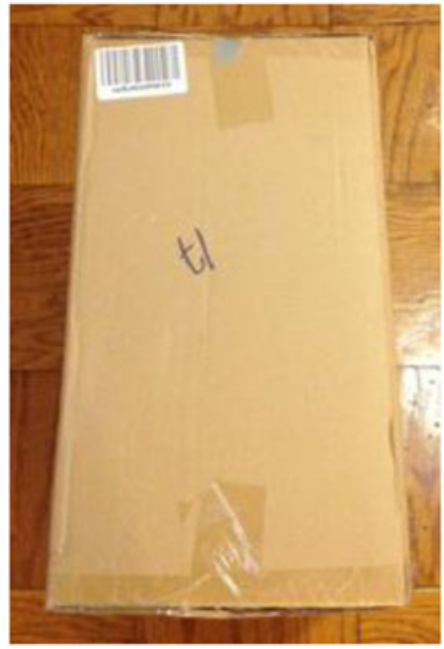

FIGURE 2 View 3 of the box

plane as its "P-shape."[10] On such a P-shape proposal, perspectival properties are analyzed as two-dimensional projections of an object's intrinsic spatial properties either onto the frontal plane or onto the retina. Appearance properties in turn are analyzed in terms of awareness of such two-dimensional projections. On such views, perceivers are aware of both an object's projected spatial properties as well as its intrinsic spatial properties. The former accounts for the appearance property, the latter for the constancy property.

It is widely accepted that two-dimensional retinal projections play an important role in visual processing. It has been argued, for example, that the visual system computes the shape of an object by first registering its two-dimensional retinal shape and then applying certain rules or "heuristics" for deriving three-dimensional structure (e.g., Pizlo, 2008). Moreover, it has been argued that an object is recognized by comparing its two-dimensional retinal projection with images of two-dimensional retinal projections stored in memory (e.g., Edelman, 1999; Ullman, 1996). Even if two-dimensional retinal projections play a role in visual processing, however, it is questionable whether we are aware of them, or of P-shapes, in standard cases of conscious perception.

A view similar to the P-shape proposal has it that spatial appearance properties should be understood in terms of awareness of the solid visual angles that perceived objects subtend (Jagnow, 2012; Tye, 2002). The solid visual angle an object subtends relative to a viewpoint is fixed by the union of rays leading from that viewpoint to the boundary of the object. A rectangle viewed at as slant subtends the same solid visual angle as a trapezoid viewed from directly above on and an object subtends a progressively smaller visual angle as it moves farther away from your viewpoint.

Assuming P-shapes do play a role in personal level conscious perception, the view would satisfy the consistency desideratum. After all, P-shapes and intrinsic shapes are different in kind, and so, awareness or representation of the former will not be inconsistent with awareness or representation of the latter. Moreover, if appearance properties are analyzed in terms of awareness of P-shapes, then the view will moreover satisfy the perspective without illusion desideratum. However, it is questionable whether appearance properties can be explained in this way while accounting for phenomenal character of spatial perception.

Several challenges facing the P-shape proposal concern its consistency with spatial phenomenology and thus its ability to satisfy the dual aspect desideratum. These challenges target the idea that P-shapes *even partially* characterize the phenomenal character of spatial perception.

The P-shape of a three-dimensional volumetric object is planar and so flat, but there is arguably no sense in which such objects look flat (Briscoe, 2008; Schellenberg, 2008; Schwitzgebel, 2006, 2011). Furthermore, it is not clear why attributing a P-shape *F* to a region of the frontal plane should make an external object look *F*, nor is it clear why perceptually representing an external object as being related to a certain P-shape *F* should make that object look *F*. For example, it is unclear why simply representing a slanted box as projecting a trapezoidal image on the frontal plane should make the box look trapezoidal.

A further problem is that the distortions to an object's shape appearance as a result of slant are in general less extreme than the distortions to its P-shape (see Hatfield, 2009: ch. 6, Hatfield, 2016; Hill, 2014: Chapters 11–12; Hill & Bennett, 2008; Thouless, 1931). Similarly, the reduction in apparent size as an object recedes into the distance is less drastic than the reduction in the size of its projection onto a particular frontal plane—its "P-size." While the solid visual angle view avoids the criticism that objects don't look flat, the view faces similar difficulties to the P-shape proposal (Hatfield, 2016; Hill, 2014). Namely, distortions to an object's shape appearance with increasing slant are in general less extreme than distortions to its solid visual angle.[11]

If the P-shape theorist claims that the apparent shape or size of an object changes in direct proportion to its P-shape or P-size, then these observations pose a serious difficulty for the view. The P-shape theorist might accommodate these data by claiming that P-shapes (or properties of projecting certain P-shapes) are simply *misrepresented* in experience and thus give up the perspective without illusion desideratum (see Hill, 2009: 164–165 for an argument against this view). However, the P-shape view will fail to satisfy either the dual aspect desideratum or the perspective without illusion desideratum.

5.3 | Distance and slant

A third approach to analyzing appearance properties in terms of awareness of mind-independent perspectival properties is to appeal to the fact that as a perceiver shifts perspective on an object, the object's distance and slant will change relative to the perceiver. The best known scheme for visually representing distance and slant is Marr's 2½-D sketch. For each patch of a visible surface (up to a certain resolution), the 2½-D sketch specifies (a) the distance and direction of that patch from one's viewpoint and (b) the patch's orientation relative to one's line of sight (see Marr, 1982: 275–279) thus creating a depth map.[12] The distance-and-slant view analyzes appearance properties in terms of awareness of an object's distance and slant, while constancy properties are analyzed in terms of awareness of intrinsic shape and size properties (Briscoe, 2008; Hopp, 2013; Siewert, 2006; Smith, 2002).

How does the distance-and-slant view fare with respect to our desiderata? The view can satisfy the consistency desideratum: There is no inconsistency between an object's intrinsic shape and its distance and slant relative to your viewpoint, so there is no inconsistency in being aware of these properties concurrently. Moreover, it satisfies the perspective without illusion desideratum: Since an object's distance and slant really do change with changes in viewpoint, there is no illusion involved in representing them as changing. Finally, if appearance properties are analyzed in terms of the awareness of distance and slant properties while constancy properties are analyzed in terms of the awareness of intrinsic properties, then the distance-and-slant view satisfies the dual aspect desideratum. It is highly plausible that our awareness of intrinsic shape alongside distance and slant offers at least a partial account of the phenomenal character of spatial perception.

While the distance-and-slant view does well in satisfying our desiderata, it is been criticized on grounds that it does not fully account for the phenomenal character of spatial perception. The distance-and-slant view does not register any respect in which farther objects "look smaller" than closer objects. Farther objects, on this view, simply look farther away. Similarly, the view does not register any respect in which a slanted rectangular surface may "look trapezoidal." Rather, it simply looks rectangular and at a slant. To the extent that one is attracted to the intuition that slanted rectangles look trapezoidal or slanted circles look elliptical, one will not be attracted to the distance-and-slant view.

There are at least two options available to the defender of the distance-and-slant view. Either she can deny that slanted objects have compressed shape appearances and that farther away objects have smaller size appearances, or she can embrace pervasive misrepresentation, and thus reject the perspective without illusion desideratum. The first option is evidently endorsed by A. D. Smith: "[T]he suggestion that pennies, for example, look elliptical when seen from most angles is simply not true.... Such a penny (usually) looks just the way it is: round and *tilted away from you*" (Smith, 2002: 172; see also Siewert, 2006).[13] On this view, all that changes as regards the experience of an object's spatial properties when it is slanted away from you is its perceived depth and slant properties—a slanted rectangle does not look trapezoidal *in any respect* nor does a slanted circle look elliptical.

How viable one finds this approach will obviously depend on how committed one is to the view that shape and size appearances change depending on an object's orientation and distance. The idea that a slanted rectangular surface looks in some way trapezoidal is readily grasped by participants in psychology experiments. When asked to report the shape that an object "looks" or "appears" (rather than its real physical shape), participants will often indicate a shape that is somewhat compressed relative to the object's real shape (Thouless, 1931; Wagner, 2006: ch. 6).[14] As such, the "trapezoidal" appearance of a slanted box does seem to have psychological reality. In response, some proponents of the distance-and-slant view have argued that these compressed shape properties are not generally represented in perception. Instead, we represent them only as a result of taking up a special imaginative perspective on the perceived object (Briscoe, 2008).[15]

The second option is to combine the distance-and-slant view with a view on which physical shape and size are systematically misperceived. On this option, when we perceive a rectangular surface at a slant, we perceptually represent it as being physically somewhat trapezoidal, and also as slanted relative to our line of sight. Likewise, when we perceive train tracks that recede away from us, we perceptually represent them as physically converging in the distance. Consistent with this, there is psychological evidence that as objects get farther away, our perception of their length along the depth dimension becomes progressively more compressed (e.g., Wagner, 1985, 2006: ch. 7; Loomis, Da Silva, Fujita, & Fukusima, 1992). On this view, a circular object that is slanted in depth should look slightly elliptical, because its perceived length from front to back will be compressed relative to its perceived length from left to right. This proposal obviously requires giving up the perspective without illusion desideratum. At bottom, however, it is an empirical question whether we are subject to pervasive geometrical illusions.[16]

5.4 | Situation-dependent properties

A fourth approach to analyzing appearance properties in terms of awareness of mind-independent perspectival properties is to appeal to situation-dependent properties (Schellenberg, 2008). Situation-dependent properties are a kind of perspectival properties. They are extrinsic, mind-independent properties that are exclusively sensitive to and ontologically dependent on intrinsic properties and the situational features. Situational features are features of the environment that determine the way an object is presented. For the perception of size, shape, and other spatial properties, the perceiver's location in relation to the perceived object is the crucial situational feature that determines how the object is presented. For the perception of color and shading, the lighting conditions and color context are among the crucial situational features. A situation-dependent property is determined by a (nonconstant) function of an intrinsic property of the object and relevant situational features. This means that fixing the intrinsic properties and the situational features fixes the situation-dependent properties (Schellenberg, 2008: 57–60).

Consider again Sam who sees the box first in View 1 and so straight on and then in View 2. In both cases, the box is presented in a certain way given his location. In View 2, one side of the box is closer than the other; one part faces away from him. The box's shape is presented in an egocentric frame of reference, which in turn means that the object and its parts are presented as standing in specific spatial relations to Sam. The way the box is presented to Sam's location is on the suggested view an external and mind-independent, albeit, situation-dependent property of the world. Any perceiver occupying the same location would, ceteris paribus, be presented with the same situation-dependent property—though perceivers differ with regard to which situation-dependent properties are perceptually available

to them and they differ in how they represent situation-dependent properties. On this approach, we represent both intrinsic properties and situation-dependent properties. Appearance properties are analyzed in terms of awareness of situation-dependent properties, while constancy properties are analyzed in terms of awareness of intrinsic properties.

The situation-dependent properties approach easily satisfies the dual aspect desideratum. After all, we perceive and are aware of both the perspectival properties and intrinsic properties in our environment. As a consequence our perceptual experience is characterized by both appearance properties and constancy properties.

The situation-dependent properties approach satisfies the consistency desideratum. To see why, consider Peacocke's case of two same-sized trees one of which is further away than the other. According to the situation-dependent properties approach, a subject who sees the trees represents two distinct properties: An intrinsic property and a situation-dependent property. While the representation of the intrinsic property grounds the sense in which trees look the same size, the representation of the situation-dependent property grounds apparent difference in size. Since the intrinsic property and the situation-dependent property are different in kind, the representational content is not inconsistent. This is the case even if both properties are attributed to the same objects.

The situation-dependent properties approach satisfies the perspective without illusion desideratum. After all, appearance properties are analyzed in terms of awareness of mind-independent situation-dependent properties. So there is nothing illusory about seeing situation-dependent properties. Indeed, appealing to situation-dependent properties allows us to analyze many cases as non-illusory that philosophers—but not psychologists—typically treat as visual illusions. Examples are the bent look of a stick partially immersed in water or the red look of a white wall immersed in red light (Schellenberg, 2008: 74–75).[17]

Aspects are a kind of situation-dependent property, but situation-dependent properties include more than just aspects. In contrast to P-shapes, situation-dependent properties are not projections and are not two-dimensional. They are three-dimensional. Schellenberg (2008) has argued that one important advantage of the situation-dependent property approach over the distance-and-slant approach is that the perceiver need not be aware of slants and distances to perceive situation-dependent properties. Perceiving slants and distances is, Schellenberg contends, an intellectually sophisticated activity. If this is correct, then in contrast to the distance-and-slant approach, the situation-dependent property approach does not over-intellectualize perception. While situation-dependent properties are relational properties in that they are a function of intrinsic properties and situational features, they need not be perceived as relational properties. Indeed, one may not be aware of the situational features in any way but may only be aware of the property constituted by the intrinsic property and the situational features as if it were a monadic property. Of course, even in this case the situation-dependent property may not be perceived as a monadic property.

According to the situation-dependent property view, we are normally aware of which property perceived is intrinsic and which is situation dependent, in that we are aware which property is constant and which is fleeting or relative to situational features. There are, however, cases in which we mistake a situation-dependent property for an intrinsic property, such as when we mistake a white wall illuminated by red light to be a red wall. The situation-dependent property approach can easily account for such cases and moreover can easily account for why it is that we have some reason to believe that the wall is red. After all, it is situation-dependently red. To take an example involving spatial properties, consider again Peacocke's trees. The representational content of a perception of the trees will be the following.

(*Tree*$_1$ *and Tree*$_2$ are the same size′, *Tree*$_1$ *and Tree*$_2$ are different in size′′)

The single primed property is a situation-dependent property, and the double primed property is an intrinsic property. While the two properties represented differ in kind and while the representational content marks them as different, perception need not represent these metaphysical facts. In extreme cases, the subject may just be aware that the trees are somehow the same size and somehow different in size. In contrast to the distance-and-slant view, the situation-dependent property approach can account for this while nonetheless satisfying the consistency desideratum.

One challenge for the situation-dependent property view is raised by the fact that objects have myriad situation-dependent properties. There are many properties determined as a function of an object's intrinsic properties together

with its situational features. Further developments of the view are needed in order to specify which of these properties is prioritized by the visual system in any particular case. For example, if the slanted box has a trapezoidal shape appearance, which specific situation-dependent property accounts for this appearance? A proponent of the position needs to answer this question in a way that also accommodates the data discussed earlier. For example, phenomenal shape and size appearances do not seem to change in direct proportion with either P-shapes or solid visual angles. Thus, for the situation-dependent property view to adequately capture these features of spatial phenomenology, the situation-dependent properties that account for shifts in shape and size appearance also should not change in direct proportion to an object's P-shape or solid visual angle.

6 | CONCLUSION

We have discussed a variety of approaches to explaining the perspectival aspect of perception. We evaluated each view with respect to three desiderata for a theory of perspectival variation. Now, it is an option to reject one or more of these desiderata. Indeed, it has been argued that our experience of spatial properties is systematically inaccurate (McLaughlin, 2016). A view on which experience of spatial properties is systematically inaccurate will reject the perspective without illusion desideratum.

In our discussion, we have focused primarily on views on which appearance properties are analyzed in terms of (awareness of) properties or objects, which are distinct from an object's intrinsic spatial properties. A different sort of view would hold that appearance properties are determined by perceptual modes of presentation of an object's intrinsic shape and size (see, e.g., Burge, 2010). Thus, the "trapezoidal" aspect of Sam's experience when seeing the slanted box in View 2 would be due to his perceptual mode of presentation of the table's rectangularity. This perceptual mode of presentation would be different when Sam views the box in other orientations.

As we have seen, a major fault line in disputes about how to account for the perspectival aspect of perception concerns whether there is any respect in which a slanted box looks trapezoidal, or a slanted coin looks elliptical. While some find this judgment inescapable, others do not. For those in the latter camp, the distance-and-slant view (perhaps supplemented with the aspect view) is quite plausible. Those in the former camp have, on the other hand, encountered difficulty in developing a view of appearance properties, on which the three desiderata are satisfied while giving an adequate account of phenomenal character and being sensitive to empirical data. Schellenberg (2008) has argued that the situation-dependent property approach provides the resources needed for an account of appearance properties that avoids such difficulties.

There are a variety of further issues surrounding spatial constancy and perspectival variation that we have not addressed here. While we have discussed appearance properties and perspectival properties in detail, we have said little about constancy properties, except that they may plausibly be accounted for in terms of perceptual awareness of an object's intrinsic properties. However, even if this is correct, it raises a number of further issues. First, objects have myriad intrinsic shape properties. A square object is also a rectangle, quadrilateral, and closed figure. Which of these properties are represented in perceptual experience? On this issue, Green (2017) has argued that our perceptual representation of intrinsic shape is layered at varying degrees of abstraction and that representations of abstract shape play a critical role both in visual processing and during concept acquisition. Second, there are a number of ways to understand the notion of perceptual constancy. For example, when we see a coin as circular both when viewed straight on and when viewed at a slant, does this merely involve perceiving it as circular at two separate times, or does it also involve perceiving it as remaining circular from one time to the next (Bennett, 2016; Green, forthcoming)? Given the emphasis placed on perceptual constancy in recent work within the philosophy of mind and perception (see Burge, 2010; Smith, 2002), it is important to investigate the various ways of understanding this capacity.

There are further issues regarding perceptual constancy that we have not addressed here. We have discussed the fact that when we see an object, our perceptual experience manifests perceptual constancy as our viewpoint on the object changes. There is strong evidence that perceptual experience manifests perceptual constancy in the face of

geometrical changes considerably more complex than mere changes in viewpoint. For example, many of the objects that we perceive change their intrinsic shapes as they move. This is true of biological objects, such as human beings and cats, but also of many artificial objects, such as staplers and reclining chairs. Nonetheless, such objects often perceptually appear to retain key aspects of their overall structure as they move. Green (forthcoming) argues that perceptual experience manifests a kind of perceptual constancy, called structure constancy, in response to many nonrigid objects of this sort. Green contends that structure constancy places important constraints on viable models of the representational format and reference frame of visual spatial experience.

In addition to the nature of constancy properties, a question to be addressed in a further work is how (and whether) perceivers transition from egocentric to allocentric frames of reference in perception, that is how they transition from perceiving objects in an egocentric frame of reference to perceiving them as having properties characterized in an allocentric frame of reference (Schellenberg, 2007). Another central question is how and if our visual experience of spatial properties accords with consistent geometries of visual space. Some, such as Hatfield (2009: ch. 5), take the perspectival aspect of perception to have crucial implications for questions about the geometry of visual space. We plan to address these questions among others in a second paper.

ENDNOTES

[1] Although we'll focus here on exercises of perceptual constancy across changes in perspective or viewpoint (where an object's intrinsic shape remains constant), it is also plausible that there are aspects of perceptual experience that remain constant across changes that alter an object's intrinsic shape, such as the normal walking motion of a human being (Green, forthcoming).

[2] The notion of "slant" is ambiguous, as it can refer either to the angle formed between a surface and some background surface, such as a flat ground plane, or to the angle formed between a surface and the perceiver's line of sight. The first is called *geographical slant*, while the second is called *optical slant* (see Bennett, 2016). When we speak of slant here, we'll always have optical slant in mind.

[3] Non-represenationalist views have been defended by austere relationalists or naïve realists (Brewer, 2011; Campbell, 2002; Martin, 2002). Johnston (2004) has defended a non-representationalist view that eschews many of the externalist commitments of naïve realists.

[4] This is not an obligatory view for sense datum theorists. For example, both Price (1932: 3) and Jackson (1977: 102–103) claim that sense data are arrayed in three-dimensional space, located at varying distances and angles relative to the perceiver. It is open to a proponent of this version of sense datum theory to hold that when Sam is aware of the slanted box, he is simply aware of a slanted rectangular sense datum, and so not aware of any trapezoidal object.

[5] Some, however, have rejected this claim about shape experience (Hill, 2014: 229–230; Prinz, 2012: 74).

[6] See Austin (1962) for a variety of arguments against the sense datum view.

[7] In developing his view of sensations, Peacocke (2008) proposes that the trapezoidal sensational property of experience when one views a slanted rectangle is the shape of a region of one's "visual field." The visual field is characterized as the curved plane in space that contains the retina of the (hypothetical) "cyclopean eye," which occupies a position roughly halfway between the two eyes (e.g., Hershenson, 1999: 20–21). But which region of this plane is relevant? A natural answer is that it is the region of the plane occupied by the two-dimensional projection of the distal rectangle. In this case, sensational properties bear some similarity to Noë's "P-shape" proposal, discussed below, though on the latter view, such projective shape properties figure in an experience's representational content. As such, Peacocke's view is likely to face similar problems to the P-shape proposal in accounting for the phenomenology of apparent shape (e.g., an object can project an image twice as large as another object onto the frontal plane yet not appear twice as large).

[8] These facts do not strictly entail that appearance properties must be analyzed in terms of awareness of mind-independent properties. One could, for instance, hold that different perceivers are presented with the same mind-dependent properties and that these properties reliably covary with mind-independent properties that the box has by virtue of its relation to the perceiver's location.

[9] It is an open question whether, and in what respect, a perceiver can be perceptually aware of those parts of an object that are hidden from her viewpoint (e.g., an object's backside or occluded parts). The ability to fill in the hidden parts of an object is called "amodal completion." For recent discussions of amodal completion and perceptual experience, see Nanay (2010) and Briscoe (2011).

[10] See also Tye (2000: 78–79) for a version of the P-shape account.

[11] In light of these issues, Christopher Hill (2009, 2014, 2016; Hill & Bennett, 2008) proposes that shape and size appearance properties involve awareness of "Thouless properties." These are construed as complex relational properties of objects

determined as a function of their intrinsic properties along with their distance and orientation relative to the perceiver. Thouless properties are supposed to represent a "compromise" between an object's intrinsic properties and its solid visual angle.

[12] Because the 2½-D sketch is limited to describing the geometry of *visible* surfaces, it does not include any description of the way surfaces complete behind occluders.

[13] McLaughlin (2016) joins Smith in rejecting the view that slanted objects appear compressed in shape but endorses the view that faraway objects appear smaller in size.

[14] These are often called *apparent* instructions, to distinguish them from *objective* instructions, which require the participant to indicate the spatial properties that an object actually has.

[15] Similarly, Kelley (2008) suggests that while we can come to experience a slanted coin as having an elliptical apparent shape, we cannot do this while also experiencing it as intrinsically circular.

[16] See McLaughlin (2016) for arguments that perception is subject to pervasive geometrical illusions.

[17] The bent stick case is sometimes referred to as an "optical" illusion rather than a visual illusion.

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