9

No More than Meets the Eye

Shadows as Pure Visibilia

Ian Phillips

9.1 Introduction: Shadows as Secondary Citizens

Commonsense and traditional metaphysics alike accord shadows a secondary status in the order of things, relegating them from the first rank of genuine substances.[1] Recall, for example, Shirley's famous lyric: 'The Glories of our blood and state / Are shadows, not substantial things'. Or how in Shakespeare's play, Marcus Andronicus, bemoans of his brother, Titus, that 'grief has so wrought on him, He takes false shadows for true substances' (III.ii.79–80).

Concerning metaphysics, consider this passage from P.M.S. Hacker:

> There are, of course, many things and kinds of thing that are to be found in the world around us to which we refer by means of singular referring expressions, and by reference to which we may explain various phenomena that call out for explanation, that are not substances. We refer to rainbows, reflections and shadows, to sounds and smells, to holes, gaps, knots and lumps, to waves, currents, lakes and oceans, to valleys, passes, gulfs and deltas, to the atmosphere and stratosphere . . . These are clearly not substances, although they are objects of singular reference with a rough spatio-temporal location. (2004, p. 48; cf. Hoffman and Rosenkrantz 1997, p. 1)

Hacker makes no suggestion that his miscellany of non-substances share a common insubstantial nature. Nonetheless, there are grounds for thinking that some of the entities which he lists do, at least in one way, share a nature. For, arguably, rainbows, reflections, shadows, sounds and smells are, in their nature, constitutively connected

[1] I am very grateful to both editors for extremely helpful written comments as well as for their great patience. For her generous and incisive written comments, thanks also to Hemdat Lerman. For discussion and advice I'm most grateful to Craig French, Anil Gomes, Nick Jones, Mark Kalderon, Hanna Pickard and Lee Walters. A distant ancestor of this material was presented at a workshop in York back in 2009 on Roy Sorensen's *Seeing Dark Things*. My thanks to all the participants there, and especially to the organizers and other speakers: Roy Sorensen, Tom Stoneham, E.J. Lowe, and Keith Allen for what was a very stimulating occasion.

to our experience of them. Such a form of psychological dependency would evidently distinguish them from paradigmatic substances whose nature and existence is independent and self-contained.[2]

In *The Aesthetics of Music* (1997, ch. 1) and again in 'Sounds as Secondary Objects and Pure Events' (2009), Roger Scruton defends such a view of sounds as *audibilia*: events 'essentially connected to the experience of hearing things' (2009, p. 51). In developing this claim, Scruton classes sounds alongside rainbows as 'secondary objects', entities whose 'existence, nature, and qualities are all determined by how things appear to the normal observer' (p. 59). Hacker lists shadows alongside rainbows and sounds. Here I explore whether, and in what precise sense, a view like Scruton's should be endorsed with respect to shadows.[3]

I take as my stalking horse the very different view proposed by Roy Sorensen in his important discussion of shadows in *Seeing Dark Things* (2008). Quite contrary to Sorensen's intended purpose, I argue that the hypothesis that shadows are visibilia provides a more satisfying account of the considerations which he adduces. Having motivated the conception of shadows as pure visibilia in this way, I explore one implication, namely that the science of shadows is vision science. I argue that vision science does indeed offer further support for the hypothesis that shadows are visibilia. However, it also raises a challenge: if shadows do not strictly represent independent elements of our environments, why do we perceive them at all? Why do our visual systems not simply expunge them from awareness? I close with a speculative answer to this challenge. According to this answer, shadows are not merely visual detritus but visual artefacts: creatures of the light world, carved by our visual systems in the service of the better detection and discrimination of ordinary material objects.

9.2 Shadows as Purely Visible Objects

The thesis I propose to consider is that shadows are *pure visibilia*: objects constitutively and exhaustively connected in nature, existence and qualities to our experience of them. This thesis presumes that shadows form a unified and fundamental kind. If *o* is a shadow, then *o* is essentially a shadow; 'a shadow' appropriately answers the Aristotelian question: 'What is that?' (cf. Wiggins 2001, p. 89) Such a presumption can certainly be challenged: perhaps shadows are wildly heterogeneous in nature. I set this possibility aside.

[2] Cf. Wiggins who quotes Leibniz's suggestion (in the character of *Theophilus*) that an army is not really a 'true substance' but rather 'something resultant, which is given its final touch of unity by the soul's thought and perception' (1995, p. 245). I do not of course mean to suggest that this is the only dimension along which substances and non-substances differ.

[3] The suggestion that shadows are pure visibilia is also found in various places in M.G.F. Martin's work, e.g. 2010, p. 188. I do not claim that either Scruton or Martin would agree with the way I develop this idea herein.

Our thesis also presumes that shadows are objects. This claim, though commonplace, is not uncontroversial. According to Lowe, 'an object's shadow seems better categorized as being one of its features rather than merely one of its effects. After all, an object's shadow is not "detachable" from it, in the sense that it can go on existing without the object—unlike, for example, a jet plane's vapour-trail or someone's footprint on a sandy beach' (2009, p. 618).[4] Yet, shadows *can* outlive their sources. Sorensen (2008, p. 30) offers several examples. In one 'a tree . . . is constantly illuminated as it petrifies into stone. The stone continues the shadow begun by the tree.' Sorensen also notes that, due to the finite speed of light, the moon's shadow on the earth will survive the moon's sudden annihilation by a little over a second.

Lowe also contends (2009, pp. 618–19) that unless shadows were features of objects, we would have to deny that we could see objects by seeing their shadows. In support of the contention that we can see objects by seeing their shadows, he notes that shadows play a vital role in helping us to see and recognize objects. This is undoubtedly true, and something I explore in more detail below (see sections 9.6–9.7). But Lowe's appeal to the point seems to confuse causal and constitutive senses of 'by'. Shadows play an important *causal* role in object-perception and recognition, but whether seeing a shadow ever in itself *constitutes* seeing an object is not at all obvious. Moreover, even if we did allow that we sometimes see objects in virtue of seeing their shadows, it is unclear that this would suffice to make Lowe's point. On some views, we can see an object in virtue of seeing its image, for example in a mirror or via a live video feed. We need not thereby think of the screen or mirror image as a mere modification of the object seen.

Lowe's claim that shadows are properties of objects is not the only source of resistance to the claim that shadows are themselves objects. Shadows are naturally grouped together with other light phenomena such as rainbows and reflections. Hoffman and Rosenkrantz (1997, p. 72) claim that rainbows and reflections are events akin to storms. Plausibly they would extend this claim to shadows. In my view, this would be a mistake. Shadows, rainbows and reflections are not events. Rainbows and reflections do not unfold over time in the manner of events or processes; they are not present at a time in virtue of the occurrence of some temporal part at that time. Rather they endure, being wholly present at any time of their existence (cf. Simons 2000). So too with shadows.

Henceforth, I assume that shadows are enduring objects. Thus, to say that a shadow exists is to say that a thing of a certain kind is located in a certain place, at a certain time. It is not to say that something is qualified in a certain way. Shadows can of course *themselves* be qualified in various ways. Shadows have shapes, sizes and vary at least in lightness if not colour. Shadows can endure through change. My shadow lengthens as the day draws to a close.

[4] This idea has a long history. For instance, Colliber writes: 'For we all know that Shadows are not Subſtances, but mere *Modifications* of Subſtance' (1737, p. 12).

Let *shadow characters* be maximally specific ways in which shadows are similar to and different from other shadows considered as such. Each individual shadow presents or tokens a single shadow character. If two shadows are qualitatively identical, they share a character—they are then as alike to each other in qualitative, general respects as each to itself. According to Williamson, 'Things of most kinds have depth; they can be indiscriminable without being identical. It is nevertheless tempting to believe that things of some kinds are purely superficial; for them, indiscriminability and identity would coincide' (1990/2013, p. 48). Williamson (ibid., ch. 4) focuses on the phenomenal characters of experiences: their maximally specific respects of similarity to and difference from other experiences *qua* experiences. He then offers and defends a precise sense in which such characters might be considered a subjective kind, namely just insofar as they are identical if and only if they are indiscriminable under all presentations. Williamson conjectures a generalization to other subjective kinds, i.e. other characters whose identity coincides with indiscriminability (again, under all presentations—henceforth a qualification I omit).

We can restrict indiscriminability to a particular means of knowing. Following Williamson's treatment of discriminability in terms of the activation of knowledge of non-identity, and indiscriminability in terms of the impossibility of activating such knowledge, we can think of the possibility or impossibility of activating identity-knowledge via a particular means. We can thereby contemplate kinds which are not just subjective but subjective *relative to a means of discrimination*, such as sight or smell. A visually subjective kind, then, will be one for which identity and *visual* indiscriminability coincide.

The claim that shadows are pure visibilia can be framed as the claim that shadow characters are a visually subjective kind, i.e. that two shadow characters are identical if and only if they are visually indiscriminable. Shadow characters thus contrast the characters of shoes, and ships, and sealing-wax, and other material objects whose natures extend beyond the visible—and indeed the perceptible—world. The characters of such objects have depth in Williamson's sense: the visual indiscriminability of their characters does not guarantee their identity. Two shoes can be equal before the eye, but yet differ in the way they smell, the kind of leather they are made from, the relative proportions of carbon-12 and 13 isotopes they contain, and in manifold other respects. In contrast, on the view that shadows are visibilia, shadows equal before the eye are equal in character.

This way of framing subjectivism avoids various counter-examples which face simpler views in the same spirit. For example, G.E. Moore voices a natural subjectivist thought when he writes that to say that shadows move 'perhaps only means that to any normal person they would look to be moving' (1962, p. 139; cf. ibid: section 18). As Sorensen (2008, p. 79) rightly notes, however, the Moorean view is inadequate. That a shadow looks to be moving to any 'normal' person is neither necessary nor sufficient for its actual movement. Contra necessity, consider that all terrestrial shadows move, in that they share the motion of the earth. But plenty of terrestrial shadows do not appear to

be moving in normal circumstances. Contra sufficiency, note how we distinguish the apparent motion of shadows from their real movement. Sat at the station we sometimes misperceive our own train as moving when in fact it is the train at the next platform. Similarly with the train's shadow. Plausibly the 'normal' person experiences this illusion. If so, there are shadows which look to move to a normal person but which are in fact stationary.

The claim that shadow characters form a visually subjective kind does not fall prey to these putative counter-examples. The train's shadow is not visually indiscernible from a moving shadow, nor are the movements of terrestrial shadows visually undetectable. There are presentations of each (for example, presentations to an observer on the station platform, or astronaut on the moon) from which their properties can be discerned. Our framing of subjectivism can also accommodate Casati's suggestion that the night is the shadow of the Earth despite it neither normally being seen nor thought of as such (2009, p. 329). This is arguably because its boundaries are not normally seen. Yet even if shadows must possess visible boundaries, those boundaries need not be visible under all, or even most presentations.[5]

More generally, the requirement of indiscriminability under all presentations blocks any counter-examples which exploit the indiscriminability of two qualitatively different shadows from some restricted range of perspectives. Indeed, the view that shadows are visibilia is consistent with the claim that for *any* viewing of a shadow, there is a qualitatively distinct shadow which would be indiscriminable *from that perspective*. That shadows are visibilia does not mean that perception of them is not partial (Kalderon 2007 and Hilbert 1987). What the subjectivist cannot accept, however, is the existence of qualitatively distinct yet *absolutely* indiscernible shadows. Sorensen's most striking challenge to subjectivism comes precisely from such alleged cases. To these I now turn.[6]

9.3 Sorensen on Shadow Movement

In this section, I discuss a particularly striking set of considerations which Sorensen adduces and which appear inimical to thinking of shadows as pure visibilia. These considerations again focus on the ways in which shadows move.

[5] Thanks to Clare Mac Cumhaill for prompting me to comment on this case. Contrast a case where an object is placed so as to block a hole in an opaque container, thus preventing any light at all from entering the container. In this case, despite there being an absence of light in the container caused by the object blocking light, no shadow is cast.

[6] Sorensen (2008, p. 91) proposes one other counter-example to Moore's view. The shadow of a rapidly spinning chipped Frisbee looks perfectly round and stationary. Yet photographs taken with a high shutter-speed camera suggest that the shadow does indeed move, as a slower moving chipped Frisbee shadow would look to (ibid: fig. 4.5). One response for the subjectivist to make here is to say that rapid motion can deceive the visual system, but can be visually discriminated with the aid of slow-motion cameras. Alternatively, the subjectivist might deny that what such cameras detect is really the same entity that we detect with our eyes. They might then insist that the shadow of a very rapidly spinning chipped Frisbee *is* perfectly round and stationary. By stripping out the motion (or operating with a fineness of 'shutter-speed' grain our eyes lack), a still camera does not depict the same visual world which we perceive.

Following Sorensen, imagine a perfect sphere, lit from above, which casts a perfectly round shadow. If the sphere spins, does its shadow? (Sorensen 2006, fig. 1; 2008, fig. 4.1; cf. Casati and Varzi 1994, pp. 119–20). As Sorensen acknowledges, the intuitive verdict here is that the shadow does not spin.[7] Can this verdict be explained, if correct? If incorrect, can it be diagnosed?

A critical feature of the case is that there is absolutely no visually discriminable difference between a homogenous and perfectly round shadow cast by a still sphere, and that cast by a spinning sphere (2008, p. 77). Thus, if the spinning sphere's shadow does spin, its spin is undetectable through vision. This would make it a counter-example to our thesis of visual subjectivity for it would allow for two non-identical, yet visually indiscriminable, shadow characters: those belonging to spinning and stationary spheres respectively.

But why think that the shadow does spin? After all, this is not our intuitive verdict. Sorensen's first line of argument for spin relies on his 'blocking theory of shadows' (2008, p. 12; see also pp. 92–3, 99, and 191–3). This theory is never spelled out explicitly. However, here is how Sorensen summarizes his basic reasoning in favour of spin: 'Shadows are followers of the objects that cast them. Parts of the follower correspond to parts of the leader; consequently, motion of the caster's parts accounts for motions of the shadow's parts' (p. 12, see also p. 93).

This 'argument from parts' can be spelled out as follows. Consider our top-lit sphere at time t. At t, the right-hand side of a sphere's shadow, shadow-half A, is cast by the right-hand side of the sphere, sphere-half A', and likewise the left-hand side of the shadow, shadow-half B, by the left-hand side of the sphere, sphere-half B'. When the sphere spins, the parts of the sphere move. After a turn of 180 degrees, at time $t + 1$, sphere-half A' now occupies the space which sphere-half B' occupied. But have the shadow-halves moved? According to Sorensen, his blocking theory commits him to thinking that they have, and in particular that at $t + 1$, shadow-half A now fills the space which shadow-half B filled and vice versa. Making the natural assumption that such movement of shadow-halves suffices for whole-shadow spin, Sorensen concludes that the whole shadow spins. In short, the spin of the sphere (and its parts) dictates the spin of the shadow (and its parts).

To all this, the subjectivist can retort simply by denying Sorensen's blocking theory. For even if all shadows must be *caused* by the blocking of light by a caster, it does not follow that shadows are essentially caused by that caster's blocking of light, nor that

[7] I trust here to the reader's own judgement that it is counterintuitive to think that the shadow spins. For what it is worth, Sorensen (2008, p. 97) reports that 70 per cent of his lecture audience judged that the shadow does not spin. Note further that Sorensen does accord weight to commonsense. Indeed, he deploys 'the common sense belief that a stationary sphere definitely has a stationary shadow' (2008, p. 81) in his argument against the view that an assertion of 'the shadow spins' lacks a determinate truth value. In the same context he declares, 'Common sense privileges the rest state. We ask why a rock moved, not why it remains still' (ibid.). Given this respect for commonsense, Sorensen ought to prefer a view which captures our commonsense intuitions. On these issues compare *Argle* and *Bargle's* dispute about the spinning of holes in Lewis and Lewis (1970, p. 208).

they are individuated by their casters. This point echoes one made by Scruton concerning sounds and their sources: 'even if every sound must have a cause, it does not follow that it must also be emitted by its cause, or that it must be understood as the sound of that cause' (1997, p. 2).

However, it is instructive to see that Sorensen's argument from parts is unsound even on his own blocking theory. For in making his argument from parts, Sorensen assumes that his blocking theory commits him to individuating shadow parts by caster parts. But such an assumption only holds on a version of the blocking theory which Sorensen himself explicitly, and rightly, rejects. According to that version of the blocking theory, shadows are 'dedicated dependents' (2008, p. 30) in that they always have a caster and cannot switch casters. However, Sorensen denies that this is generally true, allowing that shadows can switch casters. For example, as already mentioned, he imagines 'a tree [which] is constantly illuminated as it petrifies into stone. The stone continues the shadow begun by the tree' and offers a more extreme case where a single shadow is sustained by a potentially infinite sequence of objects, each 'seamlessly' replacing its predecessor (2008, p. 30). Yet if a shadow can change caster in this way, there is no reason that shadow parts cannot also switch caster parts. And we might suggest that this is precisely what is occurring when the sphere spins: shadow-half *A* remains stationary but is cast by a constantly changing sequence of sphere-halves. In other words, the caster part which causally sustains the shadow-part changes over time, but the shadow-part itself does not move. The argument from parts thus fails. Even though at any time, '[p]arts of the caster have parts of the shadows as effects' (2008, p. 99), this does not show that 'the shadow inherits the motion of its caster' (ibid.).

Where do these considerations leave us? We have in effect two theories. Our theory of shadows as pure visibilia, and Sorensen's blocking theory. Our theory makes a prediction: the shadow cast by a top-lit and perfectly homogenous spinning sphere, does not itself spin, since such spin cannot be visually discerned. On the other hand, as we have now seen, Sorensen's blocking theory offers no prediction concerning spin, since by denying that shadows are dedicated dependents, whether the shadow spins turns on a further, open issue, namely whether the shadow and sphere change their part-to-part relationship or not. The prediction of subjectivism is in line with ordinary intuition. Sorensen's blocking theory fails to offer a prediction (or flouts our intuitions in its dedicated dependents form). In this limited context, then, the theory of shadows as pure visibilia is explanatorily preferable.[8]

Sorensen does not leave matters here, however. He offers a wealth of considerations in favour of spin which would, of course, tell against a subjectivist approach to shadows. I turn to these now.

[8] It is a nice question what weight we should accord commonsense verdicts here. But, as already noted, Sorensen is happy to appeal to commonsense in various contexts, so he is unlikely to deny such verdicts any weight at all.

9.4 Sorensen's Surfeit of Spinning Shadows

Sorensen's discussion takes off from the following intriguing suggestion: 'A comprehensive theory of motion will encompass all moving things, not just physical objects' (2008, p. 12).[9] In particular, Sorensen holds: 'Shadows move in exactly the same sense as physical objects' (p. 78) and that, no less than those of the planets, the magnitudes of shadow movements are party to astronomical, causal reasoning (p. 80). It is unclear precisely what Sorensen means here. He might mean nothing more than that to ascribe motion to a shadow and to a planet is to ascribe the same property to both (e.g. the property of occupying a series of distinct places at distinct times). This appears unobjectionable. Yet it is also hard to see how it could represent progress. The disputants over the spinning sphere's shadow can both accept that they are disputing whether the shadow spins and so moves in the same familiar sense as ordinary physical objects. This suggests that Sorensen has a stronger claim in mind.

To explore what stronger thesis Sorensen might have in mind, let us turn to a series of variations on the original spinning shadow case which Sorensen discusses. These cases may help us understand what Sorensen has in mind in claiming that general principles of motion apply equally to shadows and physical objects. As I argue, however, they do little to persuade us that Sorensen is right to make such a claim. Instead, I argue that they further motivate the idea that the visual system provides the measure of shadow motion.

Case One: The Falling Spike

Sorensen enjoins us to imagine the spinning shadow cast by a sphere with a spike protruding from it, spinning perpendicular to a light source (see Figure 9.1; Sorensen 2008, fig. 4.2). What if the spike were suddenly to fall off? Surely, Sorensen suggests, the (now round) shadow will continue to spin.

Sorensen justifies his contention by appeal to general considerations about motion:

> Isaac Newton opposed Aristotle's presumption that rest is the natural state. Newton's first law promotes indifference between rest and motion: every object continues in its state of rest or of uniform motion in a straight line unless compelled to change that state by impressed forces.

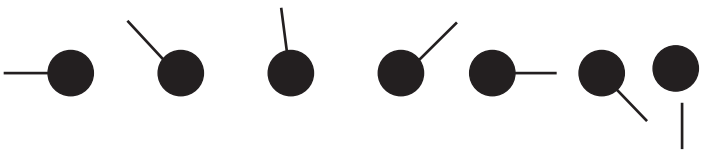

Figure 9.1. Shadow with a falling spike. © 2007, John Wiley and Sons. Reproduced with permission from Sorensen 2006, p. 49.

[9] Cf. Cummins on 'the idea that motion is the same everywhere, whatever moves, wherever and whenever it moves' (2010, p. 287).

> Perhaps Newtonians project this law on to shadows. They wince at the suggestion that the spinning shadow of a ball with a spike in it stops spinning when the spike drops off… How could sheer change of shape (to roundness) act as an instantaneous brake? Even Aristotelians have the intuition that the shadow should *gradually* slow down after the spike drops.
>
> (2008, p. 82)

What is puzzling about this discussion is that it appears to offer a *diagnosis* of why someone might be inclined to think that the shadow continued to spin. The diagnosis being that they mistakenly overgeneralize Newton's first law to shadows. Yet the context makes plain that Sorensen intends the example to *support* the contention that the spikeless shadow does in fact continue to spin. But since, as Sorensen agrees, shadows are non-material objects, and thus lack mass and energy and so 'do not trigger formulas licensing ascriptions of momentum' (2008, p. 76), it is unclear what grounds we could have for *actually* applying Newton's (let alone Aristotle's!) laws of motion to them. How, after all, does one exert a force upon a shadow to impede its motion?

Still, the shadow with a falling spike case presents a challenge. If the shadow no longer spins in the final case, what explains its sudden halt? If, as Sorensen thinks, the shadow continues to spin, what explains this? More generally: what principles govern shadow motion? Sorensen's considered answer appears to be that the motion of shadow and blocker are 'coordinated' (pp. 93–4) such that shadows 'inherit' (p. 99) the motion of their casters. What exactly does this amount to? Given the failure of the argument from parts above, it is always possible to deny that indiscernibly moving shadows are really moving (even if their blockers are) by treating them as stationary shadows seamlessly changing their casters or the relationship of their parts to their caster's parts. However, the shadow with the falling spike makes this option unappealing. For we would have to hold that with the spike attached, the shadow's movement followed that of its caster, part for part. But deny that this relationship continued as soon as the spike fell off. And it is hard to see why the loss of the spike would have this effect. It is not of course open to the blocking theorist to appeal to the sudden indiscernibility of any alleged shadow movement. From their point of view this would be a patent confusion of epistemology and metaphysics.

In contrast, on the hypothesis that shadows are visibilia, and thus that shadow motion is always visible motion, we *can* appeal to this natural thought. The shadow of the spiked sphere spins just insofar as it visibly spins. It will visibly spin insofar as the shadows of sphere and spike are grouped together by our visual system as a single visibly rotating shadow. If the spike drops off, no visibly rotating shadow-object remains, hence rotation ceases.[10]

For the subjectivist, the science of shadows is vision science (cf. Scruton 2009, p. 56). Consequently, we discover the circumstances and character of shadow motion by

[10] The subjectivist might allow that the sphere continues to spin briefly after the spike falls off since, as I suggest below, we should attach appearances not to instants but to temporally extended events, and the appearance of the shadow of a sphere which was just spinning with a now-lost spike may differ from the appearance of the shadow of a sphere which has been unchanging of late.

learning about the kinds of motion the visual system can in principle detect, and how the visual system parses the visual scene into shadows. It is natural to suppose that the shadows of sphere and spike will be grouped into a single object. Objects are perceived as 'unified, bounded, and persisting bodies' (Spelke 1990, p. 31), and loss of contact is a basic principle of disunity (scattered objects are not amongst the Spelke objects). However, it is possible—and this is an empirical matter—that the shadow of the spiked sphere is in fact visually ambiguous between a spinning shadow and a stationary shadow with a protruding shadow-spike moving around it. If so, we might think of there as being multiple shadows available as objects of perception in the case at hand, each corresponding to different parsings of the light-scene by a properly functioning visual system. The relevance and merits of these ideas can be brought out by considering Sorensen's other cases of alleged invisible spin.

Case Two: The Spinning Hemispheres

Consider two hemispherical shadows cast respectively by a spinning gold hemisphere and a spinning oak hemisphere. The spheres and shadows are of equal size and rotate at equal angular velocity (see Figure 9.2). Now imagine the hemispheres drawing closer about their common point of rotation. Finally, imagine them making contact.

Sorensen makes a number of claims about this case (2008, p. 82).

1. On contact we see what looks like a single round shadow.
2. Contact between two shadows is insufficient to make them one shadow.
3. On contact, there remain two shadows despite the appearances.
4. The motion of a shadow is not affected by its contact with another shadow.
5. What looks like a stationary round shadow is in fact two spinning shadows.

Claim (1) is very plausible. Claim (2) as a general claim is also true. Sorensen is right when he says, 'My shadow and your shadow do not become a single shadow when we shake hands' (p. 82). Consider Figure 9.3, where the intuitive shadow-count is three, not two.

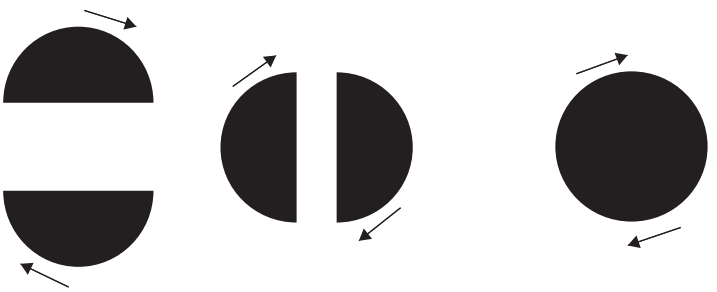

Figure 9.2. The shadow(s) of spinning gold and oak hemispheres. © 2007, John Wiley and Sons. Reproduced with permission from Sorensen 2006, p. 349.

Figure 9.3. 'Holding Mummy's Hand'—Franck Michel (CC BY-SA 2.0).

However, from the fact that in the handshake case contact is *insufficient* for unity, nothing follows concerning the hemispheres case. In particular, the denial that contact is sufficient for unity, is consistent with thinking that sometimes contact results in unity, or, as I shall say, *fusion*.

From the perspective urged above, it is natural to think of shadow fusion as occurring when the shadow cast by various casters is grouped or bound by the visual system into a single visual object. In the case of the two hemispheres, it is plausible that this occurs when the shadow cast by the two hemispheres ceases to be divided by a rectangle of light, and so the visual system treats the resultant shadow-region as a single continuous unified object.[11] If a proposal along roughly these lines is right, we have no reason to believe (3) as applied to the case in point, namely that there remain two shadows when the hemispherical shadows make contact.

From this perspective (4) is also false, both as a universal claim and in the case in point. If the two shadows fuse into one on contact, then the individual shadows no longer move for the simple reason that they no longer exist. Moreover, in line with the discussion of the spinning sphere's shadow above, the resultant shadow is stationary since it cannot be seen to move and nor is there any movement of any shadow parts. Thus, contra (5), only one stationary shadow remains and the case offers no reason to suspect that shadows can spin imperceptibly.

[11] Again, as I discuss shortly, we should attach appearances not to instants but to temporally extended events. Thus, strictly, whether shadow fusion occurs may also require that the hemispheres remain in contact for a sufficient period of time and do not, for example, bounce off one another.

Case Three: The Grating

Consider the apparently spinning shadow of a thick mesh disk under intense illumination. We see the shadow as moving 'by virtue of the tiny specks of light peppering the shadow' (p. 82). Now Sorensen asks us to imagine the situation as the light dims. As it does so, 'the specks disappear because no photons are getting through' (pp. 82–3). Thus, the shadow becomes completely black and its motion undetectable. According to Sorensen, 'We are reluctant to conclude that the shadow of the disk has stopped moving. For we do not treat change of light intensity as relevant to shadow movement' (p. 83). It is unclear who 'we' refers to here—presumably those who endorse Sorensen's 'principle that light intensity is irrelevant to motion' (p. 82). But anyone drawn to a view of shadows as entities whose nature, and specifically motion, is dependent on what can be visually discriminated will reject this principle. Change in light intensity is patently relevant to what can and cannot be visually discriminated. It follows that light intensity is relevant to shadow movement, and in the case in point, the dimming light stalls the shadow.

Case Four: The Rotating Spike

The final case of Sorensen's which I will consider is slightly more involved. However, it ultimately receives the same diagnosis. Sorensen imagines a spiked sphere which rotates away from the light source (see Figure 9.4) such that there is a brief moment when the spike is out of view. If we accept that the spiked shadow looks to be spinning prior to this moment, we are left with the question, does the shadow suddenly stop spinning?

Sorensen assumes that we will baulk at a sudden and brief cessation of motion of the shadow (2008, p. 93). However, even if we accept Sorensen's claim that the shadow continues to spin—and we may not—this does not necessarily conflict with the thought that shadow motion is visible motion. For we can explain the continued spinning in terms of *visible* spin as follows. Insofar as we see things to be moving at an instant, we do so only in virtue of seeing their motion over some extended period of time. To this end, many views of temporal experience posit a 'temporal field' or 'specious present'—a limited period of time fundamental to our awareness of movement and change.[12] Embracing such a window, it can plausibly be claimed that one can see a shadow rotating for the brief moments that the spike is occluded in virtue of seeing the shadow's motion

Figure 9.4. Shadow of rotating spike. © 2007, John Wiley and Sons. Reproduced with permission from Sorensen 2006, p. 358.

[12] For discussion of the nature of the 'specious present' see, for instance, James 1890; Broad 1923; Dainton 2000, 2010; Phillips 2011, 2014; Soteriou 2010, 2011; and Hoerl 2013.

over a surrounding window of time including those moments. Motion is visible in the window because the movement of the spike-shadow is visible throughout a longer period of time which determines the local content of our perceptual experience at times within it.[13] Visually discriminable properties again suffice to do the work. Of course, if the rotation is slowed down so that there is a period of spike invisibility greater than the length of the 'temporal field', then for this period at least, the shadow will look still. I see no reason to think that this is counter-intuitive or at odds with appearances.

I submit that similar considerations meet the intuitions pumped in Sorensen's other cases. It follows that the hypothesis that shadows are visibilia is well-equipped to provide a satisfying account of when shadows do and do not move. In this regard, Sorensen should welcome the approach. Furthermore, subjectivism proves superior to Sorensen's blocking model which either fails to provide a clear answer to questions of shadow movement or worse delivers counterintuitive verdicts. Arguably, then, far from refuting subjectivism, Sorensen's ingenious sequence of cases bolsters the theory.

9.5 Attention and the Aesthetics of Shadows

Subjectivism provides an elegant account of shadow motion. On that theory, invisible movement is no movement at all, and the movement of shadows is predictable with reference to the ways in which shadows are parsed by the visual system. Importantly, we do not look to the spin of its caster(s) in order to settle questions about a shadow's spin. More generally, we treat shadows as ontologically independent entities, caused by the blocking of light, but not more closely tied to their blockers than that.

This attitude mirrors one Scruton takes towards sounds. Scruton criticizes views of sounds which 'tie sounds too firmly to their sources' (2009, p. 62). This, he argues, contradicts 'our ordinary ways of identifying sounds, as self-dependent events that bear their nature in themselves' (ibid.). He continues that to do so 'banishes to the margin those features of sound that make sound so important to us, not only epistemologically, but also socially, morally, and aesthetically' (ibid.). In particular, Scruton argues that in musical listening we can attend to sounds in complete isolation from their sources. Following Schaeffer, Scruton terms this experience of sound, severed from its source, the ' "acousmatic" experience of sound' (1997, p. 3).

I suggest that a closely analogous possibility arises in the case of shadows, in the form of various shadow arts, including shadow puppetry and shadowgraphy (hand shadow art, or ombromanie). In many such cases, a screen is used and so strictly we are seeing silhouettes. This raises various complications. Indeed, Sorensen denies that silhouettes are shadows, instead identifying silhouettes with the back surfaces of

[13] This means that whether a shadow is moving may depend on facts about the world over durations of the length of the temporal field—perhaps several hundred milliseconds. This does not constitute a dependency which Sorensen is likely to object to. For reasons internal to his blocking theory, he holds that 'shadows do not supervene on a single time slice of the world. Although shadows depend on positive reality, that positive reality is extended over time' (2008, p. 192).

opaque objects (Sorensen 2008, chs 1–2; though see Westphal 2011). However, we can avoid this issue by focusing on shadows thrown onto a wall, as is common practice amongst children and amateur, home shadowgraphers.

Consider, then, hand-shadow puppets cast on walls by multiple objects. In such cases two (or more) hands (perhaps of different people) and sometimes other props can be used to create what we very naturally regard as single shadows. In Figure 9.5, for example, a shadow in the shape of a 'Fright' is cast using two hands. Asked how many shadows there are here, we intuitively answer one: the shadow of a face. And we answer thus even though we know that there are two casters. (Further examples are limited only by one's skill and imagination.) Although we typically know that music has multiple sources—perhaps even thousands as in some performances of Mahler's 8th—our attention is not usually focused on those sources, but on the sounds themselves: the music. In the same way, although we typically know the number of sources of the shadows we see in shadowgraphy, our attention (both as viewer and, importantly, as artist) is on the shadows themselves. Though often a mere parlour trick, the aesthetic possibilities of shadow art rely on the same kind of severance of shadows from their causes as sounds from their sources. In shadowgraphy our attention is on the shadow itself, independent of the objects which block the light.

Figure 9.5. 'Fright' from *Hand Shadows to Be Thrown upon the Wall* by H. Bursill (1859). Image available via www.gutenberg.net

Shadow art thus exploits a possibility offered by the independence of shadows and blockers. A possibility already found in relation to the case of the two hemispheres depicted in Figure 9.2. Of course, in many cases the number of blockers matches the number of shadows cast (recall Figure 9.3). But that the count of shadows sometimes matches the count of blockers of course does not show that we should in general count shadows by counting blockers.

These considerations tell against Sorensen's blocking theory which appears in tension with the kind of aesthetic possibility just discussed. I do not claim that it is impossible to construe our thought and talk of shadow art to bring it in line with a blocking theory. However, the obvious ways of doing so bring us back to the naturalness of treating shadows as independent unities. For example, we might claim that there is indeed a single blocker in a case such as the 'Fright', namely the artist's *hands*. But here, and even more obviously in more complex cases, what unifies the blockers in the relevant context is that they cast a single shadow. But this is not a verdict that the blocking theorist can help him or herself to. They must insist that the blockers settle questions of shadow unity, not vice versa. In short, these considerations underscore the naturalness of treating shadows in independence from their causes.

Hitherto, I have argued that the hypothesis that shadows are visibilia provides a more satisfying account of a variety of considerations than Sorensen's rival blocking theory. In this way, subjectivism constitutes a natural and explanatorily powerful approach to shadows. However, my argument certainly does not establish subjectivism as the correct view. For all that I have said, some other theory of shadows might do justice to a wider range of cases.[14] Nonetheless, rather than pursue this possibility, I want to consider one implication of the hypothesis that shadows are a visually subjective kind, namely that the science of shadows is vision science.

9.6 Shadows in Vision Science

Work in vision science reveals that the visual processing of information from a given region proceeds in fundamentally different ways depending on whether that region is classified as containing a shadow or a material object. Experimentally we can manipulate such processing by exploiting the different heuristics deployed by the visual system to identify whether a given luminance pattern is due to variation in light or material (Kingdom 2008). Most crudely, if we remove the presence of an implied casting object, or invert the display thereby contradicting the heuristic that illumination comes from above, we can shift the visual system from processing a region as a shadow to processing it as a material object. Using such manipulations, experimentalists have demonstrated that the visual system assigns a 'lower representational status' (de-Wit et al. 2012, p. 157) to regions classified as shadows.

[14] For alternative approaches see, in particular, Casati and Varzi (1994).

The emerging consensus (Elder et al. 2004; Lovell et al. 2009; Porter et al. 2010; de-Wit et al. 2012) is that the visual scene is first segmented into different regions at an early 'quick and dirty' processing stage, at which point regions identified as shadows are represented in a coarse-grained manner or otherwise 'discounted'. Shadow regions can be selected for 'object-based' attention based on this early segmentation process (de-Wit et al. 2012) but nonetheless lack the representational status accorded to material objects by the visual system as a result of subsequent processing. This is evinced in Rensink and Cavanagh's well-known search paradigm (Rensink and Cavanagh 2004) which reveals less efficient search times for regions interpreted as shadows—at least when to-be-searched-for differences are at a relatively fine-level of grain (Lovell et al. 2009).

Such evidence suggests that the visual system shares the view (which I began by attributing to commonsense and traditional metaphysics) that shadows are second-class citizens.[15] Their secondary status is described in different ways by different scientists. According to Rensink and Cavanagh (2004, p. 1339): 'Shadows do not correspond to structure in the world itself, arising instead from interactions between the world and the sources that illuminate it'. According to de-Wit et al. shadows 'do not represent inherent structure in the environment' (2012, p. 150). For Porter et al. the job of the visual system is to parse its input into 'physical objects and illumination-related noise' (2010, p. 16).

The basis for the various degradations of shadows by vision scientists is less than transparent. Why should 'arising…from interactions between the world and the sources that illuminate it' preclude something from being part of the structure of the world itself? Don't many structures in the world (indeed doesn't most of life on earth?) arise in part from interactions between the world and sources of light? Similarly, what is meant by the term 'inherent'? The dictionary tells us that inherent features are permanent or essential features. But is a Mayfly or snowflake any less a substance for its impermanence, or the shadow cast for centuries by an eternal flame any more so? Are any substances *essential* features of the structure of the world? And finally, if shadows are mere noise, why do we perceive them at all—why does the visual system not simply expunge them from awareness as it does with other visual detritus (cf. New and Scholl 2008)?

Thinking of shadows as pure visibilia provides a plausible explanation of their secondary status. Our target thesis was articulated simply in terms of a bi-conditional concerning shadow characters: two shadow characters are identical if and only if visually indiscriminable under all presentations. However, it is natural to think of this biconditional as grounded in a dependency. Shadows exist only insofar as they are visually perceivable; their existence is constitutively dependent on their perceptibility. This explains why they do not represent inherent structure in the environment, i.e. structure which exists entirely independently of its perceptibility. However, adopting

[15] See also Tomonaga and Imura (2010) on the role of shadows in amodal completion.

this view raises a question: why have we evolved visual systems which allow us to perceive shadows? Why do our visual systems devote resources to tracking them? Compare the issue mentioned in the previous paragraph: if shadows are mere noise, why do we perceive them at all? In the next and final section, I offer a speculative answer to this challenge.

9.7 Shadows as Visual Artefacts

Sorensen raises the issue of why we perceive shadows. He recognizes that shadow information is vitally important in object perception and recognition. But he supposes that the secondary status of shadows (as evidenced by empirical work such as that discussed in section 9.6) reveals that shadows are thereafter simply noise: 'After [shadow] information is used [at a pre-attentive level] to construct the visual scene of *objects*, facts about the shadow become an unsightly nuisance' (2008, p. 10; emphasis in original). They become a nuisance because they pose the risk of being confused for material objects. Nonetheless, as I now suggest, there are many benefits of consciously perceiving shadows which their complete censorship would surrender. Together I suggest that these functional benefits motivate a conception of shadows as *artefacts* of the visual system: carvings from the light world rendered by the visual system in order to subserve its fundamental function, namely the discrimination and recognition of material objects. On this view, shadows are a kind of visual sign-post or marker, designed to aid our exploration of the material world.

The perception of an object—either an object casting or receiving a shadow—may be shifted by the presence of a shadow. Consider Figure 9.6 below in which the robot's shadow helps determine the distance of the robot from the ground. Here we can see how the perceived location of the robot is shifted dramatically despite there being no difference in the location of the depiction of the robot in the display. Consider also the pair of figures in Figure 9.7 in which the presence of a shadow reveals the geometry of the receiving surface undisclosed in its absence.

However, although striking, these shifts only demonstrate that the visual system needs to *process* a region in a given manner on its way to a conscious percept of an object's or surface's properties. No doubt this requires the *registration* of a region as shadow. But it does not obviously require the explicit representation of shadows in conscious perception. For if the only role of shadows is to subserve the perception of objects, it is obscure why they need themselves to be explicitly represented as opposed to merely processed.

Of course, it might simply be that the explicit representation of the shadows in these situations is a contingent feature of the design of our visual systems, and so not subject to any explanation independent of contingent facts lying at a lower algorithmic or even implementational level. Explicitly represented shadows might in this sense be spandrels: by-products of the evolution of the implicit processing of regions as shadows

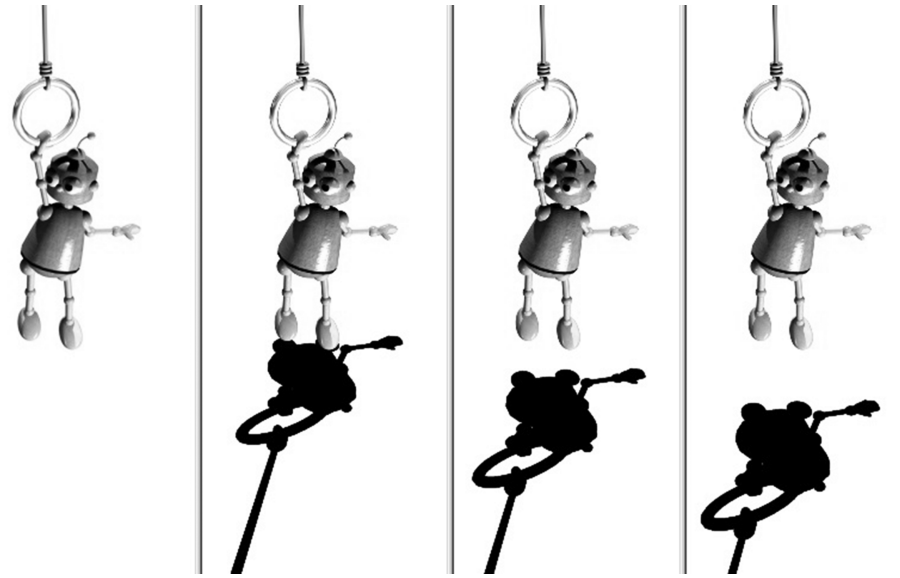

Figure 9.6. The robot's shadow helps determine its distance from the ground. © 2004, John Wiley and Sons. Reproduced with permission from Hasenfratz et al. 2003, fig. 2.

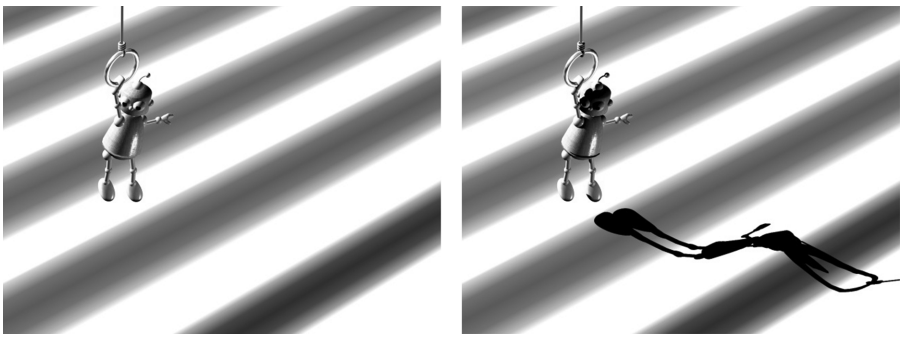

Figure 9.7. The robot's shadow helps determine the geometry of the receiving surface. © 2004, John Wiley and Sons. Reproduced with permission from Hasenfratz et al. 2003, fig. 2.

which can be seen plainly to be adaptive.[16] However, there are a number of reasons to think that the explicit representation of shadows is something which itself serves an adaptive purpose.

To take one obvious example, an object may not be in one's line of sight but yet cast a shadow which is in view. Seeing the shadow may suffice to know that there is a hidden object, and perhaps even identify it. A whimsical example is found in Figure 9.8, where

[16] This view may be correct for certain other kinds of visibilia (e.g. rainbows, glories etc.). The claims here are intended to be specific to shadows.

Figure 9.8. The robot's shadow reveals the presence of an object which is hidden from view. © 2004, John Wiley and Sons. Reproduced with permission from Hasenfratz et al. 2003, fig. 3.

the robot's shadow reveals a hidden item. More serious examples involving predators and prey are easy to imagine.

It is conceivable that the visual system might have worked differently—exploiting much richer amodal completions, and drawing on a much wider range of perceptual attributives, to represent such hidden items.[17] But it is unclear why this solution would be preferable simply to representing shadows explicitly.

As well as revealing hidden features, explicit representations of shadows also serve to convey (no doubt often indeterminate) information about out-of-view light sources (e.g. their location, size, and distance). Here too, if we did not explicitly represent shadows, vision would have to be very different to represent what shadows tell us about such out-of-view sources. Note further that insofar as leaving shadow representations explicit is beneficial, it might be more costly to be selective about this representation rather than simply to represent all shadows. Certainly such a lack of selectivity has the downside which Sorensen mentions, namely the risk of representing shadows which get confused for ordinary objects. But, at least in the healthy brain, this cost is mitigated by mechanisms intended to mark shadows as secondary (as witnessed by Rensink and Cavanagh's search paradigm results mentioned in section 9.6).[18]

Finally, we should recognize the benefits of explicitly representing shadows insofar as shadows serve as markers of places with practical relevance. For instance, shadows can hide danger, as well as hide us from danger. Shadows also mark places of shade, for example from the heat of the sun, or places to avoid if the sun is all that is keeping us from freezing. Such factors provide a further rationale for the visual system to mark and explicitly represent shadows.

[17] On perceptual attributives see Burge 2010, 2014 and Block 2014.

[18] Various studies suggest that such mechanisms might be impaired in certain populations with attendant problems (e.g. Becchio et al. 2010 on shadow perception in autism). However, see Porter et al. 2012 for evidence that such mechanisms are surprisingly robust even in patients with Alzheimer's disease.

Some of the functions served by shadow perception reflect the aetiology of shadows: that they are brought about by the blocking of light from a source or sources. But this does not return us to Sorensen's blocking view. Many human artefacts serve a similar purpose: weather vanes and wind socks, for instance. Nor does it entail that shadows should be identified with absences of light (which obviously do not constitutively depend on vision). Certainly we will want to *explain* the presence and nature of a shadow partly in terms of the absence of light, but this explanation does not require the identification of absence and shadow.[19]

On the view I am proposing, shadows are *both* pure visibilia and visual artefacts. These are distinct claims. In general artefacts are not subjective kinds in the sense articulated above. The pencils in a box may be subtly different in myriad ways which elude our senses.[20] I also make no commitment to all pure visibilia being visual artefacts. It is far from obvious that rainbows are, for example. Rather the idea mooted here is that we see shadows because our visual systems have evolved so as to parse the light world in a certain way for certain purposes. As a result, not only do the nature and existence of shadows constitutively depend on the nature of our visual system but their nature and existence is functional and so artefactual. Shadows are not merely the irritating excrescences of a visual system operating under ecological constraints but natural visual artefacts crafted to help us exploit the full range of ways in which the material world interacts with light.

References

Aranyosi, I. (2007) 'Shadows of Constitution', *The Monist*, 90(3): 315–32.

Becchio, C., Mari, M., and Castiello, U. (2010) 'Perception of Shadows in Children with Autism Spectrum Disorders', *PLoS ONE*, 5(5): e10582.

Block, N. (2014) 'Seeing-as in the Light of Vision Science', *Philosophy and Phenomenological Research*, 89(3): 560–72.

Broad, C.D. (1923) *Scientific Thought*. London: Routledge and Kegan Paul.

Burge, T. (2010) *Origins of Objectivity*. Oxford: Oxford University Press.

Burge, T. (2014) 'Reply to Block: Adaptation and the Upper Border of Perception', *Philosophy and Phenomenological Research*, 89(3): 573–83.

Bursill, H. 1859. *Hand Shadows to Be Thrown upon the Wall.* St Paul's, London: Griffith and Farran.

Casati, R. (2009) 'Are Shadows Transparent? An Investigation on White, Shadows, and Transparency in Pictures', *RES: Anthropology and Aesthetics*, 55/56: 329–35.

Casati, R. and Varzi, A. (1994) *Holes and Other Superficialities.* Cambridge, MA: MIT Press.

Colliber, S. (1737) *The Known God: Or the Author of Nature Unveil'd.* London: Ranew Robinson.

Cummins, R. (2010) *The World in the Head*. Oxford: Oxford University Press.

[19] Cf. Scruton (2009, section 6) on rainbows as well as more generally on sounds and their relationship to the longitudinal waves generated by vibrating objects.

[20] A possibility which arguably relies on their constitution from material stuff as opposed to light.

Dainton, B. (2000) *Stream of Consciousness: Unity and Continuity in Conscious Experience*. London: Routledge.

Dainton, B. (2010) 'Temporal Consciousness', in E.N. Zalta (ed.) *The Stanford Encyclopedia of Philosophy*. Fall 2010 edition.

De-Wit, L., Milner, D., and Kentridge, B. (2012) 'Shadows Remain Segmented as Selectable Regions in Object-Based Attention Paradigms', *i-Perception*, 3: 150–8.

Elder, J.H., Trithart, S., Pintilie, G., and MacLean, D. (2004) 'Rapid Processing of Cast and Attached Shadows', *Perception*, 33: 1319–38.

Hacker, P.M.S. (2004) 'Substance: Things and Stuffs', *Proceedings of the Aristotelian Society, Suppl. Vol.* 78(1): 41–63.

Hasenfratz, J.-M., Lapierre, M., Holzschuch, N., and Sillion, F. (2003) 'A Survey of Real-time Soft Shadows Algorithms', *Computer Graphics Forum*, 22(4): 753–74.

Hilbert, D.R. (1987) *Color and Color Perception: A Study in Anthropocentric Realism*. Stanford, CA: Center for the Study of Language and Information.

Hoerl, C. (2013) ' "A Succession of Feelings, In and of Itself, Is Not a Feeling of Succession" ', *Mind*, 122(486): 373–417.

Hoffman, J. and Rosenkrantz, G. (1997) *Substance: Its Nature and Existence*. London: Routledge.

James, W. (1890) *The Principles of Psychology*. New York: Henry Holt.

Kalderon, M. (2007) 'Color Pluralism', *Philosophical Review*, 116(4): 563–601.

Kingdom, F.A.A. (2008) 'Perceiving Light Versus Material', *Vision Research*, 48: 2090–105.

Lewis, D. and Lewis, L. (1970) 'Holes', *Australasian Journal of Philosophy*, 48(2): 206–12.

Lovell, P.G., Gilchrist, I.D., Tolhurst, D.J., and Troscianko, T. (2009) 'Search for Gross Illumination Discrepancies in Images of Natural Objects', *Journal of Vision*, 9(1): 1–14.

Lowe, E.J. (2009) 'Review of Seeing Dark Things by Roy Sorensen', *Philosophy* 84(4): 615–19.

Martin, M.G.F. (2010) 'What's in a Look?', in Bence Nanay (ed.) *Perceiving the World*. Oxford: Oxford University Press, pp. 160–225.

Moore, G.E. (1962) *The Commonplace Book 1919–1953*. London: Allen and Unwin.

New, J.J. and Scholl, B.J. (2008) ' "Perceptual Scotomas": A Functional Account of Motion-Induced Blindness', *Psychological Science*, 19(7): 653–9.

Phillips, I.B. (2011) 'Indiscriminability and Experience of Change', *Philosophical Quarterly*, 61(245): 808–27.

Phillips, I.B. (2014) 'The Temporal Structure of Experience', in D. Lloyd and V. Arstila (eds) *Subjective Time: The Philosophy, Psychology, and Neuroscience of Temporality*. Cambridge, MA: MIT Press, pp. 139–58.

Porter, G., Leonards, U., Troscianko, T., Haworth, J., Bayer, A., and Tales, A. (2012) 'Dealing with Illumination in Visual Scenes: Effects of Ageing and Alzheimer's Disease', *PLoS ONE*, *7*(9): e45104.

Porter, G., Tales, A., and Leonards, U. (2010) 'What Makes Cast Shadows Hard To See?', *Journal of Vision*, 10(3): 1–18.

Rensink, R.A. and Cavanagh, P. (2004) 'The Influence of Cast Shadows on Visual Search', *Perception*, 33: 1339–58.

Scruton, R. (1997) *The Aesthetics of Music*. Oxford: Oxford University Press.

Scruton, R. (2009) 'Sounds as Secondary Objects and Pure Events', in M. Nudds and C. O'Callaghan (eds) *Sounds and Perception: New Philosophical Essays*. Oxford: Oxford University Press, pp. 50–68.

Simons, P.M. (2000) 'Continuants and Occurrents' *Proceedings of the Aristotelian Society*, *Suppl. Vol.*, 74: 59–75.

Sorensen, R. (2006) 'Spinning Shadows', *Philosophy and Phenomenological Research*, 72(2): 345–65.

Sorensen, R. (2008) *Seeing Dark Things*. Oxford: Oxford University Press.

Soteriou, M.J. (2010) 'Perceiving Events', *Philosophical Explorations*, 13(3): 223–41.

Soteriou, M.J. (2011) 'The Perception of Absence, Space, and Time', in J. Roessler, H. Lerman, and N. Eilan (eds) *Perception, Causation, and Objectivity*. Oxford: Oxford University Press, pp. 181–206.

Spelke, E.S. (1990) 'Principles of Object Perception', *Cognitive Science*, 14: 29–56.

Tomonaga, M. and Imura, T. (2010) 'Pacman in the Sky with Shadows: The Effect of Cast Shadows on the Perceptual Completion of Occluded Figures by Chimpanzees and Humans', *Behavioral and Brain Functions*, 6(38): 1–9.

Westphal, J. (2011) 'Silhouettes are Shadows', *Acta Analytica*, 26: 187–97.

Wiggins, D. (1995) 'Substance', in A.C. Grayling (ed.) *Philosophy: A Guide through the Subject*. Oxford: Oxford University Press, pp. 214–49.

Wiggins, D. (2001) *Sameness and Substance Renewed*. Cambridge: Cambridge University Press.

Williamson, T. (1990/2013) *Identity and Discrimination, Reissued and Updated Edition*. Oxford: Wiley-Blackwell.