Filosofia Unisinos
Unisinos Journal of Philosophy
19(2):161-166, may/aug 2018
Unisinos – doi: 10.4013/fsu.2018.192.07

PHILOSOPHY SOUTH

In praise of Sorensen's 'blockage theory' on shadows

Alessio Gava

ABSTRACT

In his famous book *Seeing Dark Things: The Philosophy of Shadows* (2008), Roy Sorensen put forward a 'blocking theory of shadows', a causal view on these entities according to which a shadow is an absence of light caused by blockage. This approach allows him to solve a quite famous riddle on shadows, 'the Yale puzzle', that was devised by Robert Fogelin in the late 1960s and that Sorensen presents in the form mentioned by Bas van Fraassen (1989). István Aranyosi has recently criticized Sorensen's solution to the Yale puzzle, on the grounds that it does not resist another version of the riddle, that Aranyosi calls 'the Bilkent puzzle'. A new perspective on shadows, the 'Material Exstitution View', that allegedly permits to solve both puzzles, could be adopted as an alternative. In this paper I will show that Sorensen's blockage theory can actually handle both the Yale and the Bilkent puzzle, plus another one that I put forward ('the donut puzzle'), which instead is fatal to Aranyosi's position. As Sorensen puts it, nothing aside from the original blockage of light is needed.

Keywords: Aranyosi, blockage theory, material exstitution view, shadow, Sorensen, Yale puzzle.

In this paper I will present István Aranyosi's criticism of Roy Sorensen's solution to the 'Yale puzzle' about shadows. According to Aranyosi, Sorensen's approach does not work in a new version of the riddle, the 'Bilkent puzzle,' which means that it is not a proper perspective on shadows. A new approach seems necessary and Aranyosi put forward an alternative one, that allegedly solves both puzzles. In the first two sections I present the two authors' views on shadows and their solution to the Yale puzzle, along with Aranyosi's critique of Sorensen and his solution to the Bilkent riddle. In the third section I put forward a new riddle, 'the donut puzzle,' and show that it is fatal to Aranyosi's position. In the last section I finally show that Sorensen's blockage theory can easily solve the donut puzzle and can actually handle both the Yale and the Bilkent puzzles, contrary to what Aranyosi maintains. The latter's view on shadows, instead, should be rejected.

The Yale puzzle, the Bilkent puzzle and Sorensen's 'blockage theory'

In his "The Nature of Shadows, from Yale to Bilkent" (2010), Aranyosi discusses Sorensen's solution to the so-called 'Yale shadow puzzle,' that Sorensen exposed in his famous book *Seeing Dark Things: The Philosophy of Shadows* (2008). The puzzle is presented in the form mentioned by Bas van Fraassen in *Laws and Symmetry* (1989):

[1] Universidade Estadual do Paraná. Campus Apucarana. Av. Minas Gerais, 5.021, 86800-970, Apucarana, PR, Brasil.
E-mail: alessiogava@yahoo.it

> *Although 'shadow' is often used as a count noun, it should be read below as a mass noun (as in 'How much shadow is there in the photograph?'):*
> *1. If X casts any shadow, then some light is falling directly on X.*
> *2. X cannot cast shadow through an opaque object.*
> *3. All shadow is shadow of something […].*
> *Imagine a barn casting shadow on a sunny day. A bird flies between the barn and the shadow cast on the ground. The shadow directly beneath the bird cannot be cast by the bird (by virtue of I). Nor can it be cast by the barn (by virtue of II). But no third thing can cast the shadow. Hence, III is violated.*

According to Sorensen, "the shadow appears on the far side by default. Nothing aside from the original blockage of light is needed to place shadow there" (Sorensen, 2008, p. 53). Therefore it is 'the barn's shadow,' and the flight of the bird has no influence at all in the situation.

This solution, explains Aranyosi, is in line with Sorensen's general commitment throughout his book to rejecting the counterfactual theory of causation advanced by David Lewis. In the Yale puzzle, "the actual physical process that is responsible for darkness to be present on the far side of the wall is the light-blocking process due to the interaction between light and the wall" (Aranyosi, 2010, p. 220). What counts in the barn case – and in causation in general – is not what would be the case but the *actual* physical process – according to Sorensen, at least.

Despite agreeing that 'barn' is the right solution to 'the Yale puzzle,' Aranyosi is not happy with Sorensen's 'blockage theory' – which means that Sorensen's theory is the right solution, but for the wrong reason. Swapping the position of the bird and the wall, in fact, explains Aranyosi, Sorensen's solution fails.

Imagine a bird flying between the Sun and a high wall (Sorensen's barn, if you like), so that the poultry casts a shadow on the latter. Call S* the dark patch on the ground, aligned with the Sun, the bird and the shadow cast on the wall. Is S* a part of the shadow of the wall or is it the shadow of the bird?

> *The new puzzle is damaging to Sorensen's solution to the Yale puzzle. If Sorensen's blockage theory were right, we would have to say that since it is the bird that blocks the relevant quantity of light, S* is the shadow of the bird. But this can't be the case because in the new puzzle S* would really count as being cast through the wall – the bird's shadow is actually cast on the wall; it 'stops there' as it were! (Aranyosi, 2010, p. 221).*

If it is true that, if Sorensen were right, we would have to say that S* is the shadow of the bird, then we would also have to admit that in 'the Bilkent shadow puzzle' (which is how Aranyosi calls the new version of 'the Yale puzzle') the bird 'casts two shadows,' one on the wall and one on the ground (the two of them aligned with the bird and the Sun), which might seem strange – at least if we consider a single light source, as in this case. Worse, as Aranyosi points out, S* could not definitely be cast by (part of) the wall: "given the actual physical process view of causation that Sorensen champions, since the relevant part of the wall is already shaded by the bird, [...] it can't be part of the light-blocking physical process" (Aranyosi, 2010, p. 221). Borrowing Sorensen's words, one might say that the shadow directly beneath the wall cannot be cast by the wall (by virtue of I). Nor can it be cast by the bird, however (by virtue of II). "But no third thing can cast the shadow. Hence, III is violated" (Sorensen, 2008, p. 53).[2]

This should be enough to refute Sorensen's 'blockage theory,' but Aranyosi adds another unwanted consequence of it, that allows him to call the new riddle 'the Bilkent shadow puzzle': again, given Sorensen's view of causation, "we should say that the reason it is dark at 1 a.m. in Yale (New Haven, US), when there is a huge cloud over Bilkent (Ankara, Turkey) at 7 a.m., is that Yale is in the shadow of that cloud" (Aranyosi, 2010, p. 221), which seems clearly wrong.

Aranyosi's 'Material Exstitution View' on shadows

As an alternative to Sorensen's approach, Aranyosi defends the *Material Exstitution View* (MEV), according to which shadows are not 'immaterially constituted' by parts of the regions they cover. Rather, they are "spatially determined [...] by the configuration of light that delimits the region occupied by them" (Aranyosi, 2010, p. 222). Accordingly, "proper parts of shadows are not themselves shadows" (2010, p. 223). Therefore, neither S* counts as shadow nor does S, the dark patch on the ground aligned with the bird and the Sun in the original Yale puzzle. Hence, they cannot violate (1)-(3) and we can keep viewing these principles as plausible ones.

More importantly, MEV (dis)solves 'the Yale puzzle': both in the case of the bird flying between the barn and the ground and in the case of it flying between the barn and the Sun, the cast shadow is the barn's shadow. In both cases, in fact, the dark region on the ground is the same and the light that delimits and determines it is the one passing around the barn – i.e. the light that is not blocked by it. According to this view (that might even be called 'non-blockage theory'), it is the barn that casts the shadow on the ground, irrespective of the bird flying behind or in front of it. The riddle related to 'the Bilkent puzzle' is of course solved too: it is not the pres-

[2] Which shows that 'the Bilkent shadow puzzle' is actually no different from the original 'Yale puzzle'. It will be shown, in fact, that the solution is the same.

ence of a cloud over Ankara the reason why it is dark in Yale at 1 a.m. It is because at 1 a.m. Yale is standing within the shadow of the Earth, as we learn at school.

Right, but what is a shadow anyway?

Sorensen considers it a three-dimensional volume: "the shadow is three-dimensional, for the back side of the object is not receiving light" (2008, p. 143). According to the author of *Seeing Dark Things*, we should not focus on the cast shadow, which is just an extremity of the three-dimensional one:

> *The essential connection between a shadow and its blocker is obscured by our tendency to focus on the cast shadow (the part of the three-dimensional shadow that is intercepted by a surface). [...] As dusty air reveals, the cast shadow is just an edge of a three-dimensional shadow that adheres to its blocker (Sorensen, 2008, p. 92).*

If shadows are three-dimensional volumes, however, how could they be "spatially determined [...] by the configuration of light that delimits the region occupied by them" (Aranyosi, 2010, p. 222)? In order for this to happen, light should completely surround a lightless non-opaque portion of space – with the exception of its leading edge, i.e., the part that is attached to the obtruder. But of course this can only happen with small objects, thanks to the phenomenon of light diffraction (see Figure 1).

In ordinary cases, instead, the situation is the one described in Figure 2.

As the Figure 2 shows, the 'shadow cone' is actually truncated. Its lateral surface is surrounded by light. But light does not – and cannot – surround the whole dark volume. When we consider shadows as three-dimensional entities, MEV is not an applicable principle. Accordingly, Aranyosi's solution to the Yale/Bilkent puzzle cannot work either.

Since van Fraassen presented it as a puzzle about cast shadows, however, then perhaps it is not appropriate to consider three-dimensional portions of space (volumes), but rather two-dimensional ones (surfaces). As a matter of fact, a cast shadow is "the part of the three-dimensional shadow that is intercepted by a surface" (Sorensen, 2008, p. 92) and in talks about the *Immaterial Constitution View* (ICV) or the *Material Exstitution View* (MEV) "the notion of shadow that is relevant [...] is that of a shadow cast on a surface, i.e. a two-dimensional" (Aranyosi, 2007, p. 416).

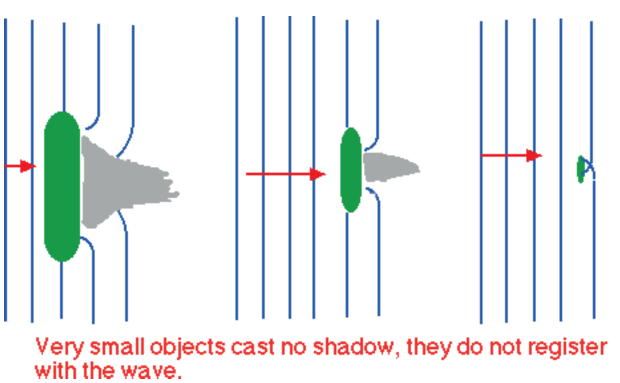

Figure 1. Wave diffraction.
Source: Karagioza (2016).

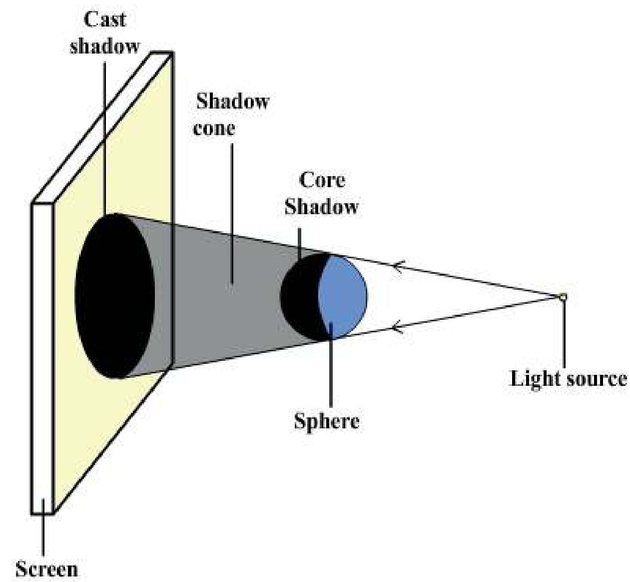

Figure 2. Formation of shadows.
Source: Science Class (n.d.).

In this case MEV works and Aranyosi invokes it for a solution to the Yale puzzle alternative to Sorensen's. As we have seen, according to the author of "The Nature of Shadows, from Yale to Bilkent", relying on MEV rather than on the 'blockage theory' can provide the same (reasonable) solution even in a new version of the puzzle, that allegedly hinders the light-blocking-process account of shadows. Other situations, however, suggest that MEV might not be such a reliable principle, when it gets to cast shadows.

The donut puzzle

Consider the state of affairs shown in Figure 3.

Imagine a big opaque ring (a big donut, if you like) standing between an opaque disk and a light source. As the picture shows, were the ring not present, the cast shadow would occupy a smaller area of the screen. Were the disk not present, instead, the cast shadow would have the shape of a ring. It appears as a dark disk, though. Common sense tells us that the central area of the cast shadow on the screen is the shadow of the disk, while the rest is the shadow of the ring. According to Aranyosi, however, the dark patch on the screen, aligned with the light source, the hole in the donut and the illuminated part of the disk – that one would probably consider as a proper part of the cast shadow (let us call it S**) – does not count as a shadow. As we have seen before, in fact, Aranyosi

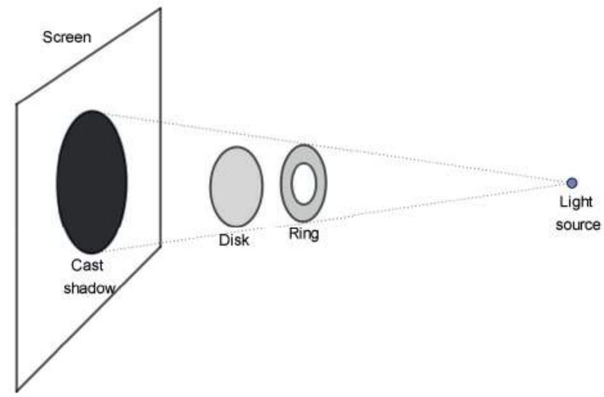

Figure 3. The donut puzzle.

maintains that "proper parts of shadows are not themselves shadows" (2010, p. 223). This means that the dark disk on the screen is but one single (cast) shadow, as we also learn from Aranyosi's account of the Yale/Bilkent puzzle: "If we adopt the material exstitution view, then neither S, nor S* count as shadows. The only shadow in the Yale puzzle is the one that is surrounded by the light that has not been blocked by the wall" (2010, p. 222).[3]

In the situation depicted in the above picture, the configuration of light that delimits (surrounds) the region occupied by the shadow cast on the screen is clearly the one that has not been blocked by the ring. The opaque disk has nothing to do with that. According to MEV, then, it seems we should conclude that it is (only) the ring that casts the shadow on the screen. But of course this cannot be the case – or else the result should be the same cast shadow that one would see were the opaque disk not present.

An advocate of MEV might reply that even admitting that what seems to be a single dark disk on the screen is actually the result of two shadows that fit together (the ring's and the opaque disk's), this would not undermine Aranyosi's solution to the Bilkent puzzle, for in the latter case the bird's shadow is 'blocked' by the wall, while in the state of affairs depicted above the opaque disk can cast a shadow directly on the screen. In other words, the situation is not the same.

Of course it is not open to an advocate of MEV to admit that there are two shadows on the screen, because light surrounds and delimits just one. Otherwise, MEV should be amended to the effect that some shadows can be delimited by other shadows and not just by light. Perhaps this could be done on the condition that 'shadow' is then used as a count noun and not, as suggested by van Fraassen, as a mass noun – which is probably not in the spirit of MEV. Note that this would not necessarily imply admitting that shadows do have parts, since S* – the dark patch on the ground, aligned with the Sun, the bird and the shadow cast on the wall in the new version of the Yale puzzle – could be seen as an independent shadow and not as a proper part of the shadow on the ground – which again is possible only on the condition that 'shadow' is considered a count noun.

Notwithstanding the foregoing, let us assume that an advocate of MEV can admit that shadows do have parts – or that two distinct shadows can fit together, one 'inside' the other. Whose shadow is S* then, in the Bilkent puzzle? It cannot be a proper part of the shadow cast by the wall, "since the relevant part of the wall is already shaded by the bird" (Aranyosi, 2010, p. 221).[4] But if S* is not cast by the wall, then the only other plausible alternative is that the caster is the bird. What if S* is considered an independent shadow and not a proper part of the shadow on the ground then? Well, this would clearly be tantamount to admitting that it is cast by the bird.

Either admitting that shadows do have parts or that two distinct shadows can fit together, one 'inside' the other, then, this would be damaging to Aranyosi, for in any case he would be forced to conclude that it is the bird that casts shadow S* – which is exactly what he wants to deny.

The only way of concluding that S* is cast by the wall (insofar as it is appropriate to speak in this way, since, according to MEV, S* does not count as shadow) is by maintaining that there is but one single shadow on the ground – in other words, that there is no such thing as shadow S*. This assumption allows Aranyosi to focus on the light surrounding the shadow on the ground and conclude that it is the configuration of light that delimits the region occupied by the shadow what determines it (see Aranyosi, 2010, p. 222). The consequence is that in both versions of 'the Yale puzzle' he can conclude that the shadow on the ground is cast by the wall and the bird has no influence at all, wherever it decides to fly.

[3] As said before, S* is the dark patch on the ground, aligned with the Sun, the bird and the shadow cast on the wall in the new version of the Yale puzzle (due to Aranyosi), in which the bird is flying between the Sun and the barn. S, instead, is the dark patch on the ground, aligned with the Sun and the bird in the original version of the Yale puzzle, in which the bird is flying behind the barn and does not receive any light from the Sun.

[4] It might be objected that this is exactly part of Aranyosi's criticism of Sorensen's 'blockage theory', therefore it is not correct to attribute a similar view to him. However, Aranyosi does not deny that shadows are the result of an interaction between a light source and an obtruder, of course: "[shadows] are ontologically dependent entities. What they depend upon is what we shall call their source. The source of a shadow is the quantity of light and the object, the obtruder, which stands in its way toward the surface where the shadow is located. There is also a condition on the environment that has to be satisfied, which is a nonzero volume of space, for which it is true that light would have penetrated it, had it not been blocked by the obtruder. The relation between a shadow and its source is causal, the latter causing the former" (2007, p. 417). There cannot be a shadow without a light source and an obtruder, whichever view on these entities one might advocate.

However, the same applies to what we may now call 'the donut puzzle', depicted in the picture above. A supporter of Aranyosi's position would be forced to admit that in the ring case the shadow on the screen is but one, for the rationale is the same as in the Yale puzzle – irrespective of the differences between the two cases. But then, she would also be forced to admit that it is the ring that casts the shadow on the screen, while the opaque disk plays no role at all – which is clearly wrong.

Nor would an appeal to Lewis's idea of causation as influence help Aranyosi's cause.[5] Quite the contrary, since this counterfactual theory seems to strengthen the view that in 'the donut puzzle' the shadow is caused exclusively by the ring. Borrowing Aranyosi's words, in fact, it might be said that it is the donut alone that exerts influence on the shadow in this puzzle. Small changes in the position or size of the donut will generate small changes in the configuration of light surrounding the shadow. Not so for the opaque disk: small changes in the position or size of the disk will have no influence whatsoever on the light-darkness configuration on the screen.

In conclusion, MEV can solve (or rather dissolve) 'the Yale puzzle' in its two versions, but clashes against 'the donut puzzle'. Something is wrong with it, then – at least when it comes to solving shadow-related riddles.

Conclusion: Defending Sorensen's blockage theory

Intuition tells us that it is the wall that casts the shadow on the ground in both the Yale and the Bilkent puzzles. According to Aranyosi, Sorensen's blockage theory could explain why this is the case in the first riddle, but fails to do it in the second one; in the Bilkent puzzle, instead, an advocate of the blockage theory is forced to admit that S*, the dark patch on the ground aligned with the Sun and the bird, is cast by the latter.

Since this is a result contrary to common sense, that even Sorensen would probably disapprove, Aranyosi concludes that the blockage theory should be rejected and puts forward an alternative approach to shadows, which he calls *Material Exstitution View* (MEV). MEV gives an apparently plausible explanation of why the shadow on the ground is cast by the wall in both puzzles, but leads to a paradoxical conclusion in another riddle, 'the donut puzzle', that I have proposed in this paper. This being so, MEV appears to be a mere *ad hoc* solution for the Yale puzzle in its two versions and not an account of shadows that can work in general.

In the donut puzzle, Sorensen's blockage theory leads to a very natural conclusion, instead: the central part of the dark patch on the screen (S**) is the shadow cast by the illuminated portion of the opaque disk, while the rest is shadow cast by the ring. Now, considering that it scores so well in the original Yale puzzle too, why not pondering a bit more on the Bilkent version of the riddle, in order to see whether we can reconsider Aranyosi's conclusion that Sorensen's approach is wrong?

If, from our star's viewpoint, a bird flies behind a barn in a sunny day, the blockage theory gives a clear and simple explanation of why the whole dark patch on the ground is the barn's (cast) shadow: it is the granary that blocks the light rays, and the bird has nothing to do with that. But if the poultry decides to fly in front of the barn, it then intercepts part of the light and casts a shadow on the wall. How could this portion of the wall cast a shadow on the ground, now that it does not intercept light anymore, asks Aranyosi? It cannot. Therefore, if one sticks to the blockage theory, one must conclude that part of the dark patch is the bird's shadow. Or reject Sorensen's approach and adopt another view on shadows, which is what Aranyosi does.

Note, however, that when the bird flies in front of the barn, the dark patch on the ground is already there. The flight of the poultry does not change the situation, nor can any difference be perceived in the shadow on the ground. In fact, the presence of the latter is due to the presence of the barn. More importantly, it is the barn the responsible for the original blockage of light. Again, "nothing aside from the original blockage of light is needed to place shadow there" (Sorensen, 2008, p. 53). That is why the flight of a bird in front of the granary is irrelevant. An advocate of Sorensen's approach *can* then maintain that the cast shadow is the barn's shadow, even in Aranyosi's new version of the puzzle.

Moreover, since Sorensen defines himself as a 'nonstickler,' he would probably add that the bird's blockage of light in the Bilkent puzzle is not of the sort that makes a difference to the scene; if the poultry were absent, the scene would look the same (see Sorensen, 2008, p. 64). Sorensen can very well conclude that the shadow on the ground is cast by the barn, then, even sticking to his blockage theory. The same rationale applies to the cloud over Bilkent, of course. The cloud has no influence whatsoever on the darkness in Yale at 1 a.m. As said before, the reason why it is dark at Yale at that time of the day is that the city is standing within the shadow of the Earth, be it cloudy in Turkey or not.

In sum, it seems that Sorensen's blockage theory about shadows scores better than Aranyosi's 'Material Exstitution View' (MEV), even when we ignore that shadows are actually three-dimensional portions of space and focus only on bi-dimensional cast ones. Three puzzles have been analyzed in this paper: the blockage theory can solve all of them, while MEV cannot. The new (banal) riddle put forward in section three is fatal to MEV, which should then be rejected, *pace* Aranyosi.

[5] Aranyosi is an advocate of it, especially when it gets to shadows: "in other earlier work on shadows I argued for Lewis's latest counterfactual theory of causation – causation as influence – as relevant in shadow related puzzles. According to this theory, C causes E iff a series of changes in E counterfactually depend on a corresponding series of small alterations in C" (2010, p. 222).

References

ARANYOSI, I. 2007. Shadows of Constitution. *The Monist*, **90**(3):415-431. https://doi.org/10.5840/monist200790329

ARANYOSI, I. 2010. The Nature of Shadows, from Yale to Bilkent. *Philosophy*, **85**(2):219-223.

https://doi.org/10.1017/S0031819110000057

FRAASSEN, B.C. van. 1989. *Laws and Symmetry*. Oxford, Clarendon Press, 395 p.

https://doi.org/10.2307/2185907

KARAGIOZA. 2016. Diffraction. Available at: http://karagioza.com/?p=1047. Accessed on: May 21st, 2018.

SCIENCE CLASS. [n.d]. Shadows, lunar eclipses and phases of the moon. Available at: http://www.physics-chemistry-class.com/light/formation-of-shadows.html. Accessed on: May 21st, 2018.

SORENSEN, R. 2008. *Seeing Dark Things: The Philosophy of Shadows*. Oxford, Oxford University Press, 310 p.

https://doi.org/10.1093/acprof:oso/9780195326574.001.0001

Submitted on May 21, 2018

Accept on August 14, 2018