

# The Power of Holes\*

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**ABSTRACT.** Firstly I define a hole as a dependent matter-less endurant, which is a little modification of Casati and Varzi's definition. Adopting this definition, holes seem to invite three problems about causation: (1)causal exclusion, (2)ungrounded disposition and (3)causal overdetermination. I will defend my definition against all these problems by showing that holes are limit cases of physical endurants rather than their opposition and that they have causal powers in a broad sense.

## 1 Reification of Holes

C. B. Martin told that holes seemed to have causal powers, showing an example of 'deadly void':<sup>1</sup>

But now suppose that someone, Alfred, is travelling toward a void, or, better still, a void is travelling toward Alfred. He would, rightly, fear for his very life and not because of things *around* the void but of the *inside* of the void itself. It seems that the void has shape and size and motion and terrible causal powers.

In view of these sentences, Martin seems to regard a void as something like a gas bomb. At the same time, however, he refused to reify a void:<sup>2</sup>

A void is not a *thing*, but it may be *how* a space-time region is.

In spite of this sentence, D. Lewis classified Martin as a nonreductive reifier as well as R. Casati and A. Varzi (abbreviated to 'C&V' henceforth), by pointing out Martin's virtual retracting it by his denial that voids are natural properties of things;<sup>3</sup> in Lewis's view, the universe or space-time is a kind of things and the state of a region or how a region is is a kind of natural properties.<sup>4</sup>

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<sup>1</sup> [Martin 1996], p.62.

<sup>2</sup> Ibid.

<sup>3</sup> Ibid., p.58.

<sup>4</sup> [Lewis 2004] p.289, n10.

I agree with Lewis in classifying Martin as a nonreductive reifier of holes, except that for Lewis it was an accusatory judgement, while for me it is rather a welcome, because I *am* a nonreductive reifier of holes, differing from Lewis as an eliminativist.

Lewis rejected reifying holes because he disliked ‘spooky’ things like holes.<sup>5</sup> Probably that may also have been the reason that made Martin refrain from admitting a hole as a thing in spite of granting that ‘it has shape and size and motion and terrible causal powers’. Most other theorists also avoid reifying holes and try to explain the apparent causal power of holes applying some causal theories: factual theory, counterfactual theory, quasi-causation theory *etc.* Against them, I will show that nonreductively reified holes are not so spooky and that we should admit them causal powers, though they must surely be limit cases of powers.

## 2 Holes as Dependent ‘Matter-less’ Endurants

Using the words ‘the complementary space of X’ as the abbreviation of ‘the complementary space of the space that X occupies’, I define holes as follows:

A hole is a matter-less endurant that has the power of fillability which emerges at an externally connected part of the complementary space of some material bodies, thanks to their shapes and arrangement.

This is a little modification of the view on holes that C&V proposed in their book *Holes and Other Superficialities*.<sup>6</sup> My modification is represented by using the awkward expression ‘matter-less’ rather than ‘immaterial’;<sup>7</sup> while the word ‘immaterial endurant’ brings up the images of ghosts and angels, which are made of, as it were, ‘immaterial stuff’, I mean by ‘matter-less endurant’ some endurant that is free of any stuff, including space as stuff. Our difference may be made clear by the following contrast:

[C&V]

Holes are made of space.

A Hole *does* not rotate. It is like still wine in a rotating wine glass.

[me]

Holes are made of nothing.

A Hole *can* not rotate. It is like the shadow of a rotating pinwheel.

The proper parts of a hole do not have any criteria of diachronic identity; a hole keeps its diachronic identity only as a whole. Besides, holes are, as it were, ‘open bodies’; since the boundary between a hole and its host does not belong to the hole itself but just to the host, a hole does not necessarily rotate even if its host and the boundary between them rotate. Therefore holes cannot rotate, in the sense that ‘rotation of a hole’ is a kind of category mistake and so meaningless. Though it may be doubtful

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<sup>5</sup> Ibid, p.283.

<sup>6</sup> [Casati and Varzi 1994]

<sup>7</sup> Probably another (important, if it is,) modification would be the word ‘endurant’, since C&V seem to be four-dimensionalists and so prefer ‘perdurant’.

that a shadow is a kind of endurants, we can find similar description of some quantum particles; *e.g.* the rotation of a one-atom-molecule is also meaningless.

By assimilating holes to shadows and quantum particles rather than ghosts and angels, we can avoid a dualistic ontology of the material and the immaterial. Holes are not opposing to physical and natural endurants but their limit cases. In other words, we can compare a hole to the empty set; though it is essential for the empty set to be member-less, it does not follow that it is some opposition to normal member-full sets; it is just a limit case of normal sets.

### 3 ‘Horizontal’ Emergence of Holes

One reward of avoiding dualistic ontology is that we can keep the causation related with holes within the causal closure of the physical world. However, it invites another problem; how can a matter-less thing have power or disposition and cause anything? Usually dispositional properties are grounded by some ‘categorical’ properties of their subject; *e.g.* the solubility of sugar is grounded by its molecular structures. That’s why C&V assigned ‘space’ as the stuff of holes to ground the disposition of fillability, which they attributed to holes.

According to my definition, the power or disposition of holes ‘emerges’ thanks to the arrangement and shapes of material bodies. This view originates from C&V. Probably the only difference between us may be concerning whether we should admit ungrounded disposition, so-called ‘pure power’.

So my point would be attributing ‘emergent pure power’ to holes. Can it be justified? It must be admitted that it is a peculiar kind of emergence, since usually emergent properties and its basic properties belong to the same subject and have the ‘vertical’ relation of macro-micro. In contrast, in the case of holes, the fillability and its basic property have different subjects: a hole and its host. Moreover, they both lie at the same level of scale and so we have to say that this case is, as it were, a ‘horizontal’ emergence.

Though it is a unique type of emergence, if it really is, it has what could be called ‘reverse causation’, which corresponds to the ‘downward causation’ in the normal ‘vertical’ emergence; *e.g.* a hole at the bottom of a ship can make it wrecked and a ventilating opening of a room keeps its walls and floor dry. In these cases a hole has some effects on its host, which is the parallel to the downward causation, where emergent properties affect its basic properties.

Regardless of whether we can take the power of holes as emergent, we cannot deny that holes act as causes. Martin’s deadly void is a typical example. J. Shaffer also gave another example in electronics:<sup>8</sup>

Such electron-hole pair generation is routinely understood as causal: “The electron absence created by this process is called a hole.” And: “These positively-charged holes can cause a catastrophic negative shift in the threshold voltage of the device” (Wall and Macdonald, 1993).

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<sup>8</sup> [Schaffer 2004] p.203.

As for the ungroundedness of the power of holes, G. Molnar insisted that nobody had proved that there could not be ungrounded powers. He described the power of some subatomic particles as the possible examples of ungrounded power.<sup>9</sup> Of course there are many differences between the power of subatomic particles and that of holes; according to a traditional distinction, the former is an active power, while the latter may be a passive power or a liability. Besides, the former is doubtlessly intrinsic to its subject, while the latter has to be extrinsic trivially, because it follows from my definition of a hole that it cannot exist without its host, which means that the power of a hole cannot exist without entities other than its subject.

However, the distinction between an active power and a passive one may not be metaphysical but just conventional; J. McKitrick insisted that the fragility of some material, which was a typical liability, could contribute to the active power of explosiveness, when the material was used as a component of a bomb.<sup>10</sup> Martin's deadly void is also the case where an ordinary passive fillability changes into an extreme active power. For another example, we could interpret the disposition of water absorbency both as active and passive. McKitrick also gave the examples of extrinsic dispositions such as weight, vulnerability and visibility.<sup>11</sup> Generally speaking, it is my strategy to accept the power of holes by adopting McKitrick's 'dispositional pluralism':<sup>12</sup>

Dispositional terms attribute a wide variety of kinds of properties to objects: intrinsic and extrinsic properties, reducible and irreducible properties, essential and non-essential properties, natural and unnatural properties.

Our disposition ascriptions are neutral with respect to whether the dispositions are reducible or irreducible, bare or grounded, essential or non-essential, inert or efficacious.

Surely the fillability is a very unique disposition and we should say that it is a limit case of dispositions. It may be instructive here to remind that Hume regarded the solidity or impenetrability of material bodies as a secondary or dispositional quality against Locke, who classified it as a primary or categorical quality.<sup>13</sup> Solidity might be also a limit case of dispositions which is at the opposite side of fillability.

## 4 Holes and Supervenience

Finally let us consider the causal overdetermination related with holes. Basically the dependence of a hole upon its host is a weak dependence in the sense that it is not specific but generic; it does not require any 'specific' material body but only 'some'

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<sup>9</sup> [Molnar 2003] pp.125-142.

<sup>10</sup> [McKitrick 2009] p189.

<sup>11</sup> [McKitrick 2003] p.159.

<sup>12</sup> [McKitrick 2009] p191,195. G. Ryle and N. Cartwright also had similar views: [Ryle 1949] p.198, [Cartwright 1999] p.64.

<sup>13</sup> [Hume 1978] I. iv. 4, pp.208-209.

material one to exist. So Tutankhamen's nostrils survived his death by his being mummified, though I am not sure whether his soul also did. However, we cannot deny that a hole 'supervenes' upon its host in the sense that a hole cannot change its shape without changing the shape of its host. Therefore we cannot avoid the problem of causal overdetermination which J. Kim most perspicuously pointed out in the context of the philosophy of mind.<sup>14</sup>

The concept of supervenience is ambiguous and its implication on the ontological dependence and causation is not clear. Moreover, it is arguable that Kim's criticism of nonreductive physicalism of mind may have some defects. Keeping away from these big questions, however, I want to cling to the fact that the way of supervenience of a hole upon its host is different from that of a mind upon a body; the difference that I showed concerning the horizontal emergence of holes can be applied to the supervenience of holes. So Kim's argument may not be applicable to the supervenience of holes.

Actually I could give a proof that a hole is a cause of some event even though it supervenes upon its host; now suppose that someone stumbled over a stone on the ground. In that case the stone is the cause of her falling. Next suppose that there was a bump which has the same shape and size with the stone just described and that someone stumbled over the bump. In this case the bump is similarly the cause of his falling. Finally suppose that somebody missed her step upon a hole and fell down. In this case we would have to say that the hole is the cause of her stumbling.

Here it is to be noted that the shape of the bump supervenes upon that of the ground. In spite of this, we should say that it is the cause of someone's falling down in the same way the stone is the cause of another's stumbling. Then we should say that the hole is also the cause of someone's falling down even if its shape supervenes upon that of its host, that is, the ground. I believe that this case is a counterexample to the thesis that the supervenience of a hole makes its power redundant.

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<sup>14</sup> [Kim 1998], [Kim 2005] etc.

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