

Getting Causes from Powers, by Stephen Mumford and Rani Lill Anjum. Oxford: Oxford University Press, 2011. Pp. xvi + 254. H/b £35.00.

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In this book, Mumford and Anjum advance a theory of causation based on a metaphysics of powers. The book is for the most part lucidly written, and contains some interesting contributions: in particular on the (lack of) necessary connection between cause and effect and on the perceptibility of the causal relation. I do, however, have reservations about some of the book's central theses: in particular, that cause and effect are simultaneous, and that causes can fruitfully be represented as vectors.

## 1. Overview

Mumford and Anjum advance a theory of causation based on a metaphysics of powers. On their view, causation is a relation between property instances (p. 1). Properties are clusters of powers (p. 3) and powers are dispositions (p. 4)—a conjunction of views which the authors term ‘pandispositionalism’ (p. 3). In virtue of the powers or dispositions which they comprise, properties are able to produce certain effects. A disposition or power is something that has possible manifestations, though it may exist unmanifested (p. 5). The manifestation towards which a disposition disposes determines its identity:

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the disposition whose manifestation is being broken (/dissolved/stretched) is fragility (/solubility/elasticity) (pp. 5, 224). The manifestation of a power is a property: that is—on the pandispositionalist view—a further power or cluster of powers (p. 5). The fire is hot. This means, perhaps among other things, that the fire has a power or disposition to warm nearby objects. Causation occurs when this disposition manifests: that is, when the objects are warmed (p. 6). In general, powers are productive their manifestations and so causation occurs when powers exercise themselves (pp. 6, 7).

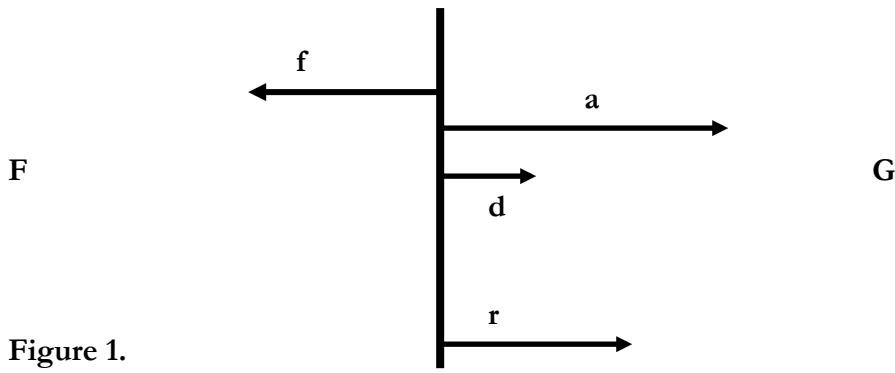
Causation doesn't involve necessary connections (Chapter 3). It doesn't even involve 'natural necessity', let alone metaphysical necessity (pp. 52-3). The reason for this is that—even setting aside the fact that causal powers may operate only probabilistically (pp. 77-81)—causal powers or dispositions can always be interfered with, offset, or outweighed by countervailing powers, so that their characteristic manifestations are not produced (pp. 53-4). (*Comment:* this is surely correct of the sorts of factors that are normally considered causes, viz. localised events or property-instances occupying small regions of space-time.) For example, the power of the fire to warm surrounding objects may be outweighed by the operation of an air conditioner, which may have a stronger countervailing power to cool them. Indeed, in almost all causal transactions, effects are produced as the upshot of many powers working all at once (p. 12, 22). The upshot depends on the nature and strength of the respective powers.

The authors take this to suggest an analogy between powers and forces. In classical physics, various forces act upon an object at a given time (e.g. a stone simultaneously experiences the gravitational attraction of both the Earth and the moon), and indeed various *types* of force (gravitational, electromagnetic, frictional, elastic, etc.) may act on an object at a time. These *component* forces can be represented as *vectors* (or 'arrows') in *Euclidean space*, whose direction represents the direction in which the component force operates, and whose length represents the intensity of the force. Given

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vectorial representations of each component force acting upon an object, the direction and magnitude of the resultant force can be derived via the parallelogram law of vector addition: arrange the component vectors  $\mathbf{c}_1, \dots$ , and  $\mathbf{c}_n$  tip-to-tail, then the resultant is represented by a vector  $\mathbf{r}$  that has its tail at the tail of  $\mathbf{c}_1$  and its tip at the tip of  $\mathbf{c}_n$ .

The authors' idea (Chapter 2) is that, by analogy, the various *causal powers* in operation on a particular object or system (e.g. the room in which the fire and the air conditioner are located) at a moment in time can be represented as vectors within a *quality space*. In the simplest case (represented as Figure 1), the quality space is one-dimensional, running from some quality  $F$ , at one extreme, to some (incompatible) quality  $G$  at the other (p. 23). (The authors allow also for multi-dimensional quality spaces—pp. 44-6.)  $F$  might be the quality of being *hot* and  $G$  of being *cold*. The quality space has a vertical line in the middle, which represents a momentary state of the object or system: for example, the temperature of the room at some particular time (p. 24). Vectors plotted in this space represent the dispositions or causal powers in operation at that moment (*ibid.*). For example, the fire possesses a power to warm, and this power is represented as a vector  $\mathbf{f}$  in the direction of  $F$ . The air conditioner (we might suppose) possesses a more intense power to cool, represented by the (longer) countervailing vector,  $\mathbf{a}$ , in the direction of  $G$ . There may be other powers at work: for instance a draught in the room, which also possesses a power to cool, but one of lesser intensity than the air conditioner, and which is represented by the short vector,  $\mathbf{d}$ , in the direction of  $G$ .



**Figure 1.**

The authors' suggestion is that, given a number of powers at work in a causal situation, the powers—like forces—may combine in an additive way so that the situation overall disposes with a certain magnitude in one direction or the other (p. 28). For example, our vectors **f**, **a**, and **d** (representing component powers) compose (via the vector addition rule) into a resultant vector, **r**, representing the overall causal disposition of the situation (pp. 28-9).

While on the authors' account, causation doesn't involve necessary connections, the dispositional modality that it *does* involve is an unHumean ingredient of the causal relation. The dispositional modality is *sui generis* (Chapter 8): causes dispose towards their effects in a way that is ‘more than purely contingent but less than purely necessary’ (p. 10). No reductive analysis of powers/dispositions is possible (p. 5). Powers/dispositions can't be reduced to their categorical bases, nor can they be analysed in terms of conditionals concerning what would happen if certain stimuli were applied (pp. 8, 190-3). One reason for believing this is inductive: all efforts to produce a satisfactory reductive analysis have failed (p. 7-8). A second reason is that powers are directly (non-inferentially) perceptible (pp. 9-10). Since causation is to be understood in terms of powers, and since the notion of power/disposition is itself a causal notion—and, specifically, a primitive, unanalysable causal notion—no reductive analysis of causation is possible (p. 7).

On the authors' view, the dispositional modality is one that we perceive as causal agents and patients (Chapter 9). The sensory modalities of touch, balance and (especially) proprioception are the primary conduits for direct (non-inferential) experience of the dispositional modality (p. 196). Perception of it via the modalities of sight, sound, taste and smell is, by contrast, theory-dependent (inferential) perception (*ibid.*). Proprioception is important because it involves the feeling (in our muscles) of required effort to, for example, lift a heavy object (pp. 207-8). In performing such an act, one can feel (muscularly) how much effort is required to accomplish a task, allowing one to make appropriate adjustments to one's actual effort (pp. 208-9). Proprioceptive experience reveals the two distinctive features of the dispositional modality: namely, directedness (with a certain intensity) towards a certain outcome and preventability (pp. 209-11). You attempt to lift a weight: your effort (or exercise of causal powers) is directed at the weight's lifting. You also feel the power of the weight to resist being lifted. Proprioception 'allows us to get the sense of power acting upon our bodies that we are able to overcome and also power exercised by our bodies that meets with resistance' (p. 209).

According to the authors causes and effects are simultaneous (Chapter 5), though this doesn't mean that causation is instantaneous (p. 109): the exercising of powers (the cause) and the manifestation that is their upshot (the effect) may be temporally extended events, simultaneously present for the duration of a causal process which takes time to elapse (p. 109-10, 122-3). For example, a cube of sugar's power of solubility and the water's power as a solvent exercise for the duration of the time that it takes for the sugar to dissolve. The upshot of a (possibly temporally extended) process of simultaneous causation is a further set of causal powers (e.g., those comprising the water's newfound sweetness), which may then feed into a further process of simultaneous causation (e.g., one involving the stimulation of the 'sweetness receptors' on the tongue of a drinker).

## 2. Comment

I wish to comment on three aspects of the view developed by Mumford and Anjum. The first two of my comments will be brief, the concluding comment will be longer.

My first comment concerns the alleged perceptibility of a non-Humean causal connection. I think that it is indeed plausible that *if* we ever directly perceive some such connection, then it is part of our phenomenology as agents and patients. Yet the question of what exactly is the immediate (non-inferential) content of this experience is difficult to adjudicate, and the authors' view on this matter will certainly be contested by the Humean. I think that the question as to whether to admit unHumean powers into our ontology will therefore inevitably end up being disputed at least partly on theoretical grounds, where one relevant consideration is whether the powers-based ontology has the ability to provide a plausible account of the causal relation. My third comment (below) will cast doubt upon whether the authors have succeeded in showing it to be able to do so.

My second comment concerns the alleged simultaneity of the causal relation. What the authors say in this connection appears simply to be inconsistent with current physical theory. The notion of absolute simultaneity has no place in relativistic physics. Simultaneity is reference-frame relative. Moreover, *if events (or property-instances) c and e are simultaneous relative to any frame whatsoever, then unless c and e occupy precisely the same space-time location, the two events lie outside of each other's future light-cones.* This means that they cannot be connected by a causal process without violation of the relativistic prohibition of causal processes that propagate faster than light. The authors consider such an objection (pp. 119-21). Their response is that, on their theory, cause and effect are collocated so that there is no faster-than-light propagation of influence between them: 'the melting of the ice cube is a process occurring in the glass, the stove is in the same

room it heats, and the colliding billiard balls touch' (p. 121). But this is inadequate. The billiard balls merely 'touch': they do not occupy the same point (or set of points) in space-time. Momentum cannot therefore be imparted instantaneously (in any frame) without violation of the relativistic prohibition on super-luminal transfers of conserved quantities (similar points apply to the spatially extended processes by which ice cools a drink, and a stove heats a room).

My final, and most substantive comment concerns the authors' use of vectors to represent causal powers. My concern is as follows. The central aim of this book is to show that 'if one adopts a metaphysics of powers or real dispositions, one of the benefits would be a theory of causation' (p. viii; see also p. 4). The demonstration that this is so is, I take it, conceived as (among other things) a contribution to the project of exhibiting the explanatory superiority of the powers-based ontology vis-à-vis the Humean ontology. Moreover, the vectorial representation of powers plays a key heuristic role in the authors' development of a powers-based theory of causation. Yet the vectorial representation is highly misleading. This casts doubt upon the success of the authors' project.

That the vectorial representation of powers is misleading can be seen by noting certain crucial disanalogies with a case in which the use of vectors is clearly appropriate: namely, in the representation of classical forces. The first important disanalogy is that there is a common metric in which component *forces* can be measured, and in which resultant forces can be calculated, viz. Newtons. The existence of a common metric is a prerequisite for their being *representable by vectors in a common space*, let alone for their composing by means of vector addition.

It would be nice if we had a common metric for representing causal factors. We might dub the unit of measurement the 'Hume'. We might claim (of our earlier example) that the fire disposes in the direction of *warming* with an intensity of 1 Hume, while the air conditioner disposes towards *cooling* with an intensity of 1.5 Humes, and the draught

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with an intensity of 0.5 Humes. Given this common metric, we could then calculate that the resultant disposition is in the direction of cooling with an intensity of 1 Hume. It would be nice if we could develop such a causal calculus, but this is a pipe dream.

Maybe—in order for the composition of causes to work analogously to vector addition—it isn’t necessary that we have a common metric in which the intensity of *all* causes can be measured, but merely that a common metric apply to all of the causal factors in operation in each particular causal situation. But what is the common metric in which the dispositions of the fire, air conditioner, and draught can be measured? *Joules?* *Degrees centigrade?*—It is at best questionable whether any such proposal can be made to work out. Or take another example given by the authors, in which *F* stands for bodily health and *G* for ill health, where your taking calcium tablets, eating a balanced diet, and getting enough sunlight dispose towards good health, and your being tired, stressed, and over-caffinated dispose towards ill-health. It seems incredible that there could be any common metric (*WeightWatchers® PointsPlus®* values?!) in which the disposition of factors towards or away from good health can be measured.

But if there is no common metric, then we have no business representing the factors as vectors in a common space (as we can with classical forces), let alone supposing them to compose by vector addition in that space. A consequence is that—in disanalogy to component forces—vector addition procedures cannot be used to derive predictions or explanations of the upshot of multiple causal powers operating in concert (contrary to the authors’ suggestion at pp. 136–7). At best, we can only make qualitative, after-the-fact judgments about which dispositions ‘won out’ in a particular case: judgements which a vectorial (mis)representation can play no role in facilitating.

The absence of a common metric for causal powers appears, in part, to be a reflection of a deeper fact: that while component forces compose in a linear, additive fashion, the linear, additive composition of causal factors seems to be the exception

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rather than the rule. This points to a further limitation of the vector model of causation, which can be illustrated with reference to a standard case of causation considered by the authors (pp. 31-2): namely, the striking of a match on a rough surface in the presence of oxygen, resulting in a flame. Of this, the authors say:

Certainly, the vector model can explain what is going on .... Although some powers disposed towards lighting, they were balanced out by other factors that disposed away from it. The oxygen is mixed with less flammable gases, the flammable tip of the match also contains chemicals that ensure adequate stability so as not to light spontaneously. Until the match is struck, we have, therefore, an equilibrium situation. Striking the match is the occasion that takes the situation out of equilibrium. It is the extra power that gets added to what was previously a zero resultant. (p. 32)

This appears to misrepresent the situation. As a matter of fact, matches don't typically contain stabilizing chemicals that prevent spontaneous combustion. Depending on the type of match, spontaneous combustion is prevented either by separating the match heads from the striking surface ('strike anywhere' matches) or (in the case of 'safety' matches) by separating the oxidizing agent (potassium chlorate, which is located on the match head) from the initial combustant (red phosphorus, located on the striking surface). Likewise, it is surely a misrepresentation to think of oxygen as a causal factor that disposes in the direction of combustion, a disposition that is balanced out by its mixture with less flammable gases, disposing away from combustion. It is not as though the presence of pure oxygen (even in the presence of an unstruck match) would lead to spontaneous combustion.

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So it is not plausible to think of the initial state as a finely balanced equilibrium between a collection of independent, non-interacting, operative powers disposing towards combustion, and a collection of independent, non-interacting, operative powers disposing away from combustion (as when the velocity of an object remains constant due to an exact balance between component forces acting upon it), with the balance finally being tipped in the direction of combustion by the addition of friction-generated heat. (Don't say: the *absence* of heat was an actually exercising causal power disposing away from combustion that exactly counterbalanced the exercising powers of the chemicals and the oxygen to produce combustion. Firstly, the authors maintain that absences lack causal powers and therefore cannot act as causes (pp. 131, 143-8). Secondly, such a claim would be vacuous in the absence of some way of quantifying the independent contributions made by the various causal factors at work.)

On the contrary, what we have here is a number of reactants (potassium chlorate, red phosphorus, oxygen) that, when brought together in the presence of an enabling condition (the heat generated by the friction of striking), engage in a series of chemical reactions that produce combustion. As this example helps to illustrate, causal factors are very often *interactive*: that is to say, their causal contributions to some effect are typically determined via interactions with the other causal factors that are present. (In general, the causal world is a world of *enabling conditions*, *disabling conditions*, *catalysts*, *switches*, *intensifiers*, *inhibitors*, *neutralizers*, and so on.) Interaction between causes in the production of an effect leads to non-linearities in composition, ensuring that the overall influence of a set of causes isn't factorizable into separate and independent contributions attributable to the individual causal factors. (This is in contrast to resultant forces, which are factorizable into ontologically independent components.)

The authors end up acknowledging this fact admitting, firstly, that (unlike component forces) there are some causal powers that simply could not operate alone (p.

38). The phosphorus's power of flammability, which cannot be exercised in the absence of oxygen, would be a good example. Second, they ultimately endorse a principle of *compositional pluralism* (pp. 96-101): namely, the principle that there are a variety of ways in which powers can compose, with additive, linear composition being just one among many possibilities.

The trouble with all this is that it is just to concede that causal powers often aren't very much like classical forces. Moreover, the features that typical causal powers fail to share with forces are precisely those that allow forces to be represented vectorially. One reflection of this is that the authors are forced to introduce some rather *ad hoc* constraints on the vectorial representation of causal powers (e.g. p. 38).

The authors adopt the vectorial representation because it is 'suited to display many of the features of a dispositional theory of causation' (p. 20), and is thus 'amenable to a dispositionalist ontology' (p. 46). In particular, they claim, the vectorial representation helps us to 'understand [the notion of] disposing towards an effect' (p. 19), and also the notion of 'many powers working with each other or against each other' and doing so with 'different intensities' in the production of an effect (p. 22). Understanding these features 'is a vital step in seeing the dispositional nature of causation' (p. 22). My worry about all is that, if a representational system that is particularly felicitous in enabling the understanding of some theory is distortive of what we know to be true about what that theory purports to explain, then that seems a *prima facie* reason to question the truth of the theory. I have here argued that vectorial representation, which is alleged to be so apposite in helping us to understand the powers-based ontology, and for helping us to understand causation in terms of that ontology, is distortive of what we know to be true about causation.

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