

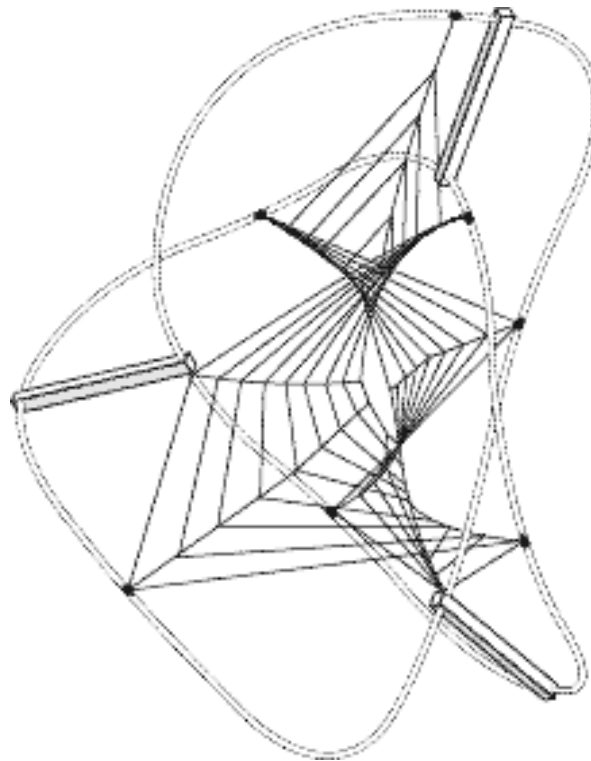
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What Makes a Capacity a Disposition?

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1 Introduction

Many, if not most of our highly prized “laws” of physics cannot be adequately rendered as statements of regular association among the values of “occurrent” quantities, I have argued.¹ This is true even if we do not balk at the concept of natural necessity and are willing to add that the associations hold “by law”. They are rather ascriptions of capacities. They tell us what capacities a system will have by virtue of having a given property. The law of gravity is one example. A system of mass M has the capacity of strength GMm/r^2 to move another object of mass m a distance r away towards itself. I shall call this *the gravitational capacity*. My second thesis is a commonly shared one. Ascriptions of capacities do not reduce to conditionals involving only categorical properties.

I shall here discuss two questions about these theses: 1) Why think of capacities as akin to dispositions or powers; and 2) Why allow them in science? Before tackling the first question, I shall first try to figure out what features we expect to be characteristic of dispositions and powers themselves.

2 What makes a disposition a disposition?

There are a number of features on account of which we might call something a disposition or a causal power:

- a. *Substance causation*. The causal relata are not events but rather the cause is an enduring substance and the effect a change in another substance. This was Aristotle’s view; so too Kant’s according to Eric Watkins.² On account of this Watkins ascribes to Kant a causal power view. But this does not seem to be true of what I have called “capacities”. It seems, rather, that it is the having of a mass by the first object at a given time that causes the motion of another at that time; and this looks far more like event causation than like causation by an enduring substance.
- b. *Latency*. Dispositions are not always on display. If that is so, the capacity of one mass to move another is not a disposition.
- c. *Conditionality*. Dispositions are generally thought to be closely connected with conditionals. The simplest connection is “If C , then disposition D will M ” where C is a description of some specific conditions, including perhaps something that triggers the disposition, and M is a manifestation. Stuart Hampshire, however, has argued the contrary. Hampshire maintains that this criterion holds for what he calls “causal properties” but not for descriptions of human character and disposition, which have mistakenly been assimilated to causal properties.

He argues, “Such causal properties of things, as being magnetised and being soluble in *aqua regia*, manifest themselves, if at all, in specific and

¹Cf. Cartwright 1989.

²Watkins forthcoming, ch. 6

definitely statable reactions, which can be produced in specific and statable conditions. The incidents which may count as manifestations of human dispositions – of intelligence, ambition, generosity, and honesty – are *essentially* various and these words are vague, summary, interpretive and indeterminate”.³ It may seem that the gravitational capacity is a paradigm causal property and hence satisfies the conditionality condition. I think not: what I call “capacities” are, I maintain, like human dispositions – essentially various. I shall return to this topic.

- d. *Malleability*. There are a number of things that can usually be done to dispositions to affect their manifestations. There are three that seem most central: interfering, triggering, and enhancing or retarding. The gravitational capacity does not need triggering – it seems to operate all the time. Nor, it seems, can it be enhanced or retarded. But it can be interfered with. This is a central feature of all the things I call “capacities”.
- e. *Two-sidedness*. There is a distinction between the occurrence of a disposition and its being manifested. There is no such distinction for categorical properties. Of course to use this as a characterization of a disposition we must at the same time also recognize the concept of a manifestation, and manifestations themselves may be difficult to characterize. Consider: having the minimal unit of electric charge is a categorical property of an electron. But it is often described as “hidden”. We have to do something very special to see that it is there. One might say that in the right kind of experiment the charge “makes itself manifest” in certain experimental results. *That* is not the sense of manifestation intended.
- f. *Missing from logbooks*. Hampshire says of a statement which refers to a disposition: “It could not be entered into a logbook of the day’s events opposite some time of the day, or in the annals of someone’s life opposite some definite date”.⁴ This I take it is in large part what it means to say that the disposition is not categorical. I suppose it is tied up with the Aristotelian idea that the power is an enduring characteristic of a substance, not one that occurs at specific times. I suppose we would not naturally enter the gravitational capacity in a logbook, nor any of the others that I think we use in science. So capacities do seem like dispositions in this respect.
- g. *Constancy of tendency*. This is the reason I introduced the idea of “capacities” into my discussion of scientific laws in the first place. The outcomes that occur when the gravitational capacity operates are indefinitely various, but there is something fixed. The first mass is always *trying* to bring other masses closer to it; we say that a mass always *attracts* other masses no matter how the other masses actually move. Capacities are modelled on John Stuart Mill’s *tendencies*;⁵ I used the word “capacity” to under-

³Hampshire 1972, pp. 37-38

⁴*ibid.*, p. 34

⁵Mill 1949/1843, book IV

line that the tendencies I was discussing are tendencies to *cause* things to happen, not just more general tendencies to behave in some particular way (*e.g.* always to move in a straight line).

The question that really troubles me here is, why assimilate capacities to dispositions? I certainly did so but I am not alone. Here are just some recent examples from Australia, a hot-bed for dispositional analysis. Alan Chalmers says that the appeal to capacities, which we both endorse, “serves to capture what is implicit in common sense usage of utterances such as ‘glass is brittle’ or ‘acorns grow into trees’”.⁶ A more thorough attempt to give an ontology of powers, dispositions and capacities appears in Brian Ellis’s book, *Scientific Essentialism*.⁷ Peter Menzies in a commentary on my views⁸ offers the same analysis for capacities, in terms of conditionals relating categorical properties, that he uses for dispositions.

Still, what have capacities, as I discuss them, to do with dispositions or powers? I suppose the connection has to do with failures not being entirely defeating conditions. One can exercise one’s power even though the result is not achieved. But that seems little connected with the central ideas defining power: control, influence, ascendancy, authority.⁹ Where is the authority? The sway over others? Nor does it have to do with what I isolated as the central feature of capacities – that the system always tries to do the same thing even if the results differ. Indeed, from another point of view, capacities seem more connected with agent causality than with powers. The mass *acts*, it does something, it operates, even if it does not achieve its objective.

This leaves me with a puzzle. Mass indeed has the feature under discussion – constancy of tendency – but I do not any longer see what constancy of tendency has to do with either dispositions or powers. This puzzle is exacerbated by returning to Hampshire’s piece on dispositions. One may not agree with all Hampshire’s requirements but I think he is fairly well attuned to the features that characterize human dispositions and character traits, many of which are not part of our current philosophical discourse – and after all, human dispositions are paradigms of dispositions. Some of these are shared by the gravitational capacity and some are not, leaving a mixed verdict. Here are the other characteristics on his list that I have not already mentioned. (The titles and summary are mine.)

- h. *Non-episodic*. “There are short-term and long-term dispositions, but a disposition cannot come into being, then pass away and then come into being again very rapidly”.¹⁰ The gravitational capacity is okay here as a disposition.

⁶Chalmers 2002 , p. 3

⁷Ellis 2001

⁸Menzies 2002

⁹*Cf. The Little Oxford Dictionary*, 1986, Oxford: Clarendon Press.

¹⁰*loc. cit.*, p. 34

- i. *Necessity of display.* “A disposition must be manifested and must show itself in actual incidents”.¹¹ Again, the gravitational capacity is okay here. Indeed recall my earlier worry that it is perhaps disqualified because it over fulfils this norm – it seems always to be on display.
- j. *Need for scrutiny in ascription.* To be confident in ascribing a disposition one must review actual incidents, looking especially for counter indications. One must thus have the opportunity for “prolonged and continuous study of the conduct and calculations of the person in question”. When one has surveyed many incidents and found virtually no contrary evidence, one can say, for example, “He is certainly and indisputably generous”. “What is claimed as certain and beyond dispute”, according to Hampshire, “is that the word ‘generous’ is so far the right word to summarise the general trend or tendency of his conduct and calculations”.¹² The gravitational capacity satisfies this requirement, but the requirement does not really seem relevant to it in the right way.
- k. *Manifestations not necessarily behavioural.* “Most ordinary character descriptions refer compendiously to a tendency discernible equally in the behaviour, and in the thought and in the feelings, of the subject”.¹³ This is clearly a feature relevant for human character traits and not for my capacities.
- l. *Wide-scope negation.* The opposite of *S has the disposition to X* is not *S has the disposition to not-X* but rather *S does not have the disposition to X*. This is true of capacities like the gravitational capacity.
- m. *Possibility of opposite behaviour.* “To attribute a disposition to someone is never to preclude that he may on some occasion act... in some way contrary to his general tendency or disposition... It is typical of human behaviour... that it allows of lapses...”¹⁴ I take it that Hampshire means we are capable of lapses even without something actively interfering with the disposition in question. Sometimes we simply do not act in character but for no special reason. I am irascible and given to nagging, but I do not always explode about my daughters’ messy rooms – and the days I don’t need not even have been particularly good ones. The gravitational capacity is not like this, it never lapses. Without positive interference the canonical behaviour will always be displayed in the attracted object. Perhaps though it is misleading to focus on the gravitational capacity. An atom in an excited state has the capacity to deexcite but the display is chancy. Should we then count a failure of the atom to deexcite in any particular case as a lapse?

¹¹ *ibid.*, p. 35

¹² *ibid.*

¹³ *ibid.*, p. 36

¹⁴ *ibid.*

Hampshire concludes from his list that statements of human disposition or character are “summarizing statements”. I am not sure if I agree. What I conclude from reflecting on my list and my worries about whether capacities are dispositions or causal powers is

Not everything that is not categorical is the same.

This is a familiar kind of lesson, but one I think we need to be reminded of since we have a tendency to look for *the* account of dispositions. There are character traits, dispositions, habits, capacities, powers; they are in humans or in non-humans; they usually derive from some underlying structure, but some may be fundamental. We could hardly expect that there are very many features that all these share.

If we wish to fix on one criterion as central it seems to me from studying my list that what must be common is

Two-sidedness: There is a distinction between the occurrence of a disposition and its being manifested.

I take it that this is not the standard choice. The primary focus is generally on conditionality. That I think is a mistake. The reasons are Hampshire’s. Human character traits and dispositions are certainly as central a member of this family as anything else. Yet, as he argues, “The incidents which may count as manifestations of human dispositions... are essentially various and these words are vague, summary, interpretive and indeterminate”. So no conditional (or set of conditionals) will capture the content of a dispositional ascription.

3 How much like other dispositions is a capacity?

If we take *two-sidedness* as the central criterion, capacities like the gravitational capacity do fall into the same family as dispositions, habits, character traits and the like. But how many of the other features associated with this family do capacities share? I want here to focus on two features from our list. The first is conditionality; this is the usual candidate for being the feature that, after two-sidedness, most firmly connects capacities with the other members of the disposition family. The second is malleability; this is my choice.

Conditionality. Many take this to be the central feature of the capacities that science studies. Peter Menzies for instance in discussing my notion of capacity offers just such a conditional account.¹⁵ It looks as if Hampshire too would count the capacity due to gravity as what he calls a causal property – satisfying conditionality – rather than assimilating it to a disposition. On the other hand, it does not satisfy his stringent criteria for the causal properties.

¹⁵*loc. cit.*

First, the incidents that count as manifestations of the gravitational capacity are indefinitely various. What actually happens to a second object when the capacity operates depends of the setting; the second can move anyway whatsoever. If we follow Gilbert Ryle's usage, though, this will make them not dispositions as opposed to causal properties, but rather "highly generic" or "determinable". Ryle explains that verbs for highly generic dispositions

... are apt to differ from the verbs with which we name the dispositions, while the episodic verbs corresponding to the highly specific disposition verbs are apt to be the same. A baker can be described as baking now, but a grocer is not described as 'grocing' now, but only as selling sugar now or weighting tea now, or wrapping up butter now.¹⁶

Second, all conditional claims linking what happens to any categorical description of the setting are, I maintain, *ceteris paribus* laws. For many philosophers this immediately makes them vague. For instance, John Earman, John Roberts and Sheldon Smith maintain that the *ceteris paribus* clause is vague and cannot be stated in a precise form.¹⁷ I claim on the contrary that it can be stated in a precise form: "*If nothing interferes*, then..." This claim is not vague, I argue, because the antecedent refers to a specific state of affairs that either obtains or does not obtain on a given occasion.¹⁸

This brings us, though, to a third possible reason why the gravitational capacity resembles Hampshire's dispositions more than his causal properties. Though not a vague word, "interference" is an abstract word, like "good" or "work". Whenever it truly describes a situation, some other more concentrate descriptions will always apply as well. But what description that is depends entirely on context, and there are no rules that can be stated using entirely categorical expressions for setting, which categorical descriptions will do in which contexts. For any context there is a fact of the matter about whether something is an interference or not; but there probably is no list – even for that context – of what are interferences. Interference is not only multiply realisable; as many philosophers stress, the list of realisations is open ended.

Conditionality, I conclude, is not then a widespread feature of capacities, at least not in any sense in which conditionality goes beyond two-sidedness. Capacities and their manifestations are different, as two sidedness demands. But there need be no set of conditionals that connects a capacity with specific manifestations.

Malleability. The central feature that locates capacities in the family of dispositions, I claim, is not conditionality but malleability. All other members of the family of dispositions, habits and character traits seem to have at least one of the three central features of malleability I mentioned: They need triggering, they can be enhanced or weakened or they may produce different manifestations, or no manifestations at all, if they are interfered with.

¹⁶Ryle 1949, p. 118

¹⁷Earman, Roberts and Smith 2002

¹⁸Cartwright 2002

So too with capacities. They are all malleable in at least the last way. They can all be interfered with, and when they are interfered with, there is no guarantee that the canonical manifestations will occur. What does occur, if anything at all, will depend on the type and method of interference and there may be no system to either the possible interferences or the possible effect they have on the capacity's manifestations. This indeed, as we have seen, is one of the chief reasons that conditionality fails. It is also why, according to many, capacities can have no place in science. I shall return to this claim at the end. For now let us consider capacities vis-à-vis the two other ways in which dispositions are commonly malleable.

With respect to the other features of malleability, the gravitational capacity that has been our focus seems to sit at the far end. As I said, it does not seem to need triggering and we have no evidence that it can be strengthened or weakened. Can other capacities? First, we should consider what this means. It does not mean that the mass of an object, which brings with it this capacity, can be increased or decreased but rather that the effect of a given mass can be changed.

This kind of change, which may seem strange in fundamental physics, is commonplace to economists. Economic relations are now almost universally expressed in equations and the equations tend to be linear in their variables (though perhaps not in their parameters). For instance, here are some equations used by Kevin Hoover¹⁹ to relate government spending at a time t (G_t) to taxes at a time t (T_t) and the rate of interest (R):

$$\begin{aligned} G_{t+1} &= \gamma + \delta[G_t - \gamma] + \varepsilon_{t+1} \\ T_{t+1} &= T_t + [(R - 1)/(R - \delta)][G_{t+1} - \delta G_t + (\delta - 1)\gamma]. \end{aligned}$$

The Greek letters are parameters. Look for instance at δ . It represents the strength of the capacity of G_t to influence G_{t+1} . It is typically supposed that the size of δ can change. In fact the important point for Hoover of writing this as a parameter rather than as a variable (since he assumes that it can vary) is that *we* have it in our power to change it. Other economists may not be so sanguine about our powers to affect things, but the idea that parameters shift is universal. What that means is that the capacities involved can be enhanced or retarded for a *given* value of the quantity that brings the capacity with it.

For a less formal example, you might want to think about the familiar “crossed-sticks” supply and demand curves. What do economists do with these? Typical questions are like this: What happens to price if the demand curve shifts upward or downward? If the supply curve shifts? Shifts in these curves are often just shifts in the slope of the line, which are represented by the parameters in front of the variables representing supply and demand in the quantity equations; that is, they represent enhancements and retardations of the capacities of demand and supply to affect quantity produced.

The natural thought about the difference between the most fundamental capacities studied in physics and the capacities studied in economics is that the

¹⁹Hoover 2001

economic capacities are derived whereas those of fundamental physics are basic. Economic features have the capacities they do because of some underlying social, institutional, legal and psychological arrangements that give rise to them. So the strengths of economic capacities can be changed, even if many in physics cannot, because the underlying structures from which they derive can be altered.

Surely that is in some sense true. But there is a puzzle – at least if current economics practices are well-grounded. It is common in economics to assume that, for the most part, the parameters are independent of each other. Each can be altered leaving the others fixed. Hoover in fact takes this to be part of the characterization of a parameter. I say “for the most part”, but not “always”. When two parameters are not independent in this sense, however, there is a tendency (which is explicit in Hoover) to suppose that the two that are not independent can be written as functions of an overlapping set of parameters, each of which is independent of the others in the set. So if θ can not be altered independently of ϕ then there is a set $\{\alpha, \beta, \gamma, \dots, \chi\}$ such that $\theta = f(\alpha, \beta, \gamma, \dots, \chi)$ and $\phi = g(\alpha, \beta, \gamma, \dots, \chi)$, and every member of this set can be altered independently of every other.

How is this possible if the alterations of the parameters involve alterations of the underlying structure? Why is it typical rather than untypical, that we should be able to change the parameters one at a time when such changes involve us in mucking about with the underlying structure? We usually know virtually nothing about this structure or how it operates. One would expect our interventions to be more like those with a sledge hammer than like surgical incisions. I shall leave this issue for discussion elsewhere since it seems more happily situated in a discussion on philosophy of economics than in one on dispositions and powers.

There is one fact, however, that has come to the fore in our brief discussion of the malleability of economic capacities that is characteristic of dispositions in general. We see here in the economics case a threefold distinction that is typical for dispositions once they reside in even slightly complex systems and that is often conflated. There is i) the disposition, ii) the property in virtue of which the system has the disposition and iii) the underlying structure that ensures that that property is associated with that disposition.

4 In defence of interference

I claim that it is characteristic of the capacities that science studies that they can all be interfered with. More strongly, the only way to state a true conditional with the canonical manifestation as consequent is roughly this:

If the capacity is triggered properly and *is not interfered with*, then the canonical manifestation will result.

We are often told that in science we are not allowed to use terms like *interference*. Abstract or umbrella terms of this sort are admissible, but they must be accompanied by *bridge principles* that link them with more concrete terms

which already have strict standards of application. The so-called “special force laws” are the paradigm of bridge principles. The abstract force function $F = GMm/r^2$ obtains when a mass m is situated a distance r from another mass M ; the abstract force function $F = \varepsilon_0 q_1 q_2 / r^2$ obtains when a charge q_1 is located a distance r from a second charge q_2 ; *etc.* We are also told that claims with the general rider “if nothing interferes” in front are untestable, indeed vacuous – they allow anything. In closing I would like to make a number of remarks about these charges.

- The absence of ‘special interference laws’ is not so epistemically damaging as many suggest. The special force laws do tell us when a particular force function obtains, but only for very specific descriptions – the descriptions that appear in our bridge principles. For other descriptions that may be applied far more immediately, such as *a truck passing by* or *the press of the wind*, we are just as much on our own without the help of a system of rules as we are in deciding if we can label the truck passing by as an *interference*.
- The lack of systematic rules does not mean that we cannot have knowledge about whether a certain kind of occurrence constitutes an interference. Galileo after all knew to use smooth planes for his rolling-ball experiments because he knew he should eliminate the interference of friction with the pull of the earth. Similarly he knew to drop small compact masses and not feathers from the Leaning Tower. And that was long before he could have had any idea whether friction or the wind exerted a *force* in the technical Newtonian sense.
- The fact that we cannot identify what counts as interference with respect to a claim does not mean that we cannot test whether that claim is true or not. Consider *Aspirins relieve headaches, if nothing interferes*. We regularly test claims like this in randomized treatment/control experiments.
- Nor does it mean that it is too easy to dismiss disconfirmations. When the predicted result fails to transpire, one can always *say* that something interfered. But saying does not make it true. And as epistemologists are always reminding us, saying, even when it is true, does not constitute knowledge, or even reasonable belief. We need a good reason for claiming that something is an interference. When we do not have any idea whether a nominated factor is an interference or not, then we equally have no idea how to classify the case. Our intended test is no test at all.
- It follows that one needs a great deal of information about what might and might not interfere with a process before we can carry out serious tests on the process and that in turn implies that we need already to have a great deal of information about the process itself. That just means that science is difficult, as we already knew, and that it is hard to get started in a vacuum of knowledge.

5 Conclusion

What makes everything in the disposition family belong there is two-sidedness. Within this family “capacity” seems especially like a power word. Nevertheless, I think that is the wrong way around to look at it. What marks out all capacities as capacities is not primarily that they enable systems to do things, but rather that they can be stopped – they can be interfered with. But that does not rule them out of science. Whether something is an interference in a given situation is a matter of fact; and it is a fact we can know about – though not in any mechanical way. But it is at any rate a big mistake to think that science could or should be mechanical.

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