

The Need for Powers
Three Models of Physical Modality

1.1 Three Models of Physical Modality

What accounts for the fact that some physical events occur while others do not? This is a question of physical modality, that is, natural necessity and possibility. Physical modality is typically conceived as narrower or more restricted than logical or metaphysical necessity and possibility.¹ Physical modality generally concerns what Carroll (1994: 7) calls the “*nommic concepts*” (italics original) such as chance, causation, and dispositions. As I see things, a conception of physical modality should at least account for possibilities consistent with our best understanding of the actual laws of nature (using the term “laws of nature” loosely so as not to assume any particular account of what laws are). In sum, it covers scientific possibilities – which constitute only some metaphysical possibilities, unless physical or natural possibility exhausts metaphysical possibility.²

Three models in contemporary analytic metaphysics have dominated the investigation of physical modality: the Neo-Humean Model, the Universals

¹ No stance is taken here on whether logical and metaphysical modalities are coextensive, only that physical modality is narrower than both of those.

² A sampling of how other philosophers conceive physical modality: Lange (2009: 45) holds that although the laws are naturally “necessary,” they could be different and could allow exceptions, unlike metaphysical, logical, or conceptual necessity; Borghini and Williams (2008: 21–22, n. 2) envision a kind of modal necessity weaker than logical or metaphysical necessity; Barker (2013: 605) envisions physical modality as including “physical necessitation and possibility, causation, disposition, and chance”; Fine (2005: 235) argues that physical (or natural) and metaphysical modalities (as well as normative modality) are each fundamental, independent notions (thus, he accepts modal pluralism); Müller (2010: 118) disagrees, claiming that physical modality is not fundamental and that the best modal notion for philosophy of science is what he calls real or historical possibility, emphasizing the connection between modal and tense operators, which Müller traces to Prior (1957).

Model,³ and the Powers Model.⁴ Each of these views aims to explain, in ontologically conspicuous ways, the unfolding of possibilities in space and time. In this chapter, I first argue (in Sections 1.2 and 1.3) that the Neo-Humean and Universals Models, while explicitly denying a place for powers in their fundamental ontologies, nonetheless involve powers. I show how these models subtly assume or can plausibly be interpreted as positing powers. As a result, I contend that the Powers Model is the way to go in explaining physical modality; however, there are different ways of conceiving powers that I outline in Section 1.4 and explore more deeply in Chapter 2.

In my critique of the Neo-Humean and Universals Models, I proceed by reversing a strategy designed by Barker (2013), who argues that (what I call) the Universals and Powers Models collapse into the Neo-Humean Model; thus, the so-called metaphysics of powers is illusory. By contrast, I contend that the Universals and Neo-Humean Models implicitly assume powers (Barker thinks the same of the Universals Model, but not the Neo-Humean Model).⁵ Therefore, the Powers Model (not Neo-Humeanism) should be the default position. But my critique of the Neo-Humean and Universals Models is limited. A comprehensive evaluation of these views would be a lengthy endeavor and trace over ground covered many times by others. My more modest goal is to investigate the issue of physical modality by showing how the Universals and Neo-Humean Models require powers.

³ The most influential Neo-Humean Model is Humean Supervenience (Lewis 1986a); the Universals Model is defended most prominently by Dretske (1977), Tooley (1977), and Armstrong (1978, 1983); and the Powers Model has prominent defenders in Heil (2003, 2012), Molnar (2003), Martin (2008), Bird (2007a), Mumford and Anjum (2011), and Williams (2019). All three models of physical modality discussed here are realist about properties and laws (although some Powers Model theorists eliminate laws; e.g., Mumford [2004] is antirealist about laws). The first two models are closely linked to laws of nature: the Universals Model holds that laws are contingent necessitation relations between universals (more on this in Section 1.3), while Neo-Humean Model proponents accept the Best System Account of laws or the Regularity Theory.

⁴ Besides their great influence on contemporary metaphysics, I focus on these three accounts of physical modality since they centrally involve the question of the nature of properties (powers or qualities?) and their relation to laws of nature. However, there are also antirealist views of laws (Mumford 2004; Van Fraassen 1989) and antireductionist views of laws (Carroll 1994, 2008; Maudlin 2007), which clearly have ramifications for physical modality. For instance, if laws are not real, the question of where physical modality comes from arises (Mumford's answer, and one with which I agree: the properties – powers – themselves); and if laws are primitive, irreducible entities, then physical modal necessities are presumably primitive and irreducible facts about the world's ordering.

⁵ What Barker (2013) calls “degrees” (first, second, and third) of physical modality I call *models*. Are the three views better termed theories, not models? If my argument is sound, then the three models discussed here all share the same underlying theory: that powers drive modality. Hence, the three views are, effectively, three models of the powers theory of modality.

In the concluding part of this chapter, after describing variations of the Powers Model, I return to the main question posed in the introductory chapter: What is the nature of powers from the inside?⁶ Stricter attention to the internal reality of powers, the focus of Part II, is necessary for a better understanding of the Powers Model and its metaphysical commitments.

1.2 The Neo-Humean Model Needs Powers

The Neo-Humean Model is antirealist about powers. Neo-Humeans accept quidditism about properties – that properties are fundamental qualities possessing a perfectly nonmodal this-ness. I will focus my discussion on Humean Supervenience (Lewis 1986a: ix–x, 1986b: 14) since this is the most influential Neo-Humean Model, although much of my critique will apply to any account of physical modality couched in terms of nonpowerful qualities behaving in accord with external lawful regularities. On Humean Supervenience, the supervenience base consists entirely of local, intrinsic, nonmodal categorical properties (qualities or quiddities) spread out over spacetime with no necessary connections between them, that is, these properties have no essential causal powers (Jaworski 2016: 82).⁷ At best, powers are derivative – certainly not found in the supervenience base of perfectly natural properties.⁸ The appearance of dispositional action and physical modality in general is explained in terms of qualities acting in accord with the contingent laws of nature, that is, fitting into patterns or regularities (see Figure 1.1).⁹ There are no primitive causal connections between events, just a series of particular facts. The qualities in the supervenience base, unchanging in themselves, will be involved in different kinds of power displays (manifestations), depending on global, nomological conditions.

⁶ For discussion of the term “inside,” see footnote 23 in the Introduction.

⁷ Lewis (2008: 209) claims that “Quidditism is to properties as haecceitism is to individuals.” The point being that each property (quiddity), like individuals (particulars) according to haecceitism, has “nothing but a (naked) primitive identity” to distinguish it from other properties (Schrenk 2017: 73). For further discussion of quidditism about properties, see Barker (2013: 611).

⁸ Lewis (1997) is committed to a reductive account of powers and provides a revised counterfactual analysis that blocks some potential counterexamples. Although powers on his view are derivative and grounded entirely on intrinsic qualities, Lewis could arguably be considered a kind of “moderate realist” about powers (Azzano 2019). See McKittrick (2021: 279–285) for further discussion of Lewis’ ontological commitments with respect to dispositions.

⁹ Lewis (1986a: xiv, 1994: 478) makes the Best Systems Account of laws central to his Neo-Humean account. On this account, laws are a select set of regularities that fit into the best system of axioms, with “best” defined by reference to simplicity and strength.

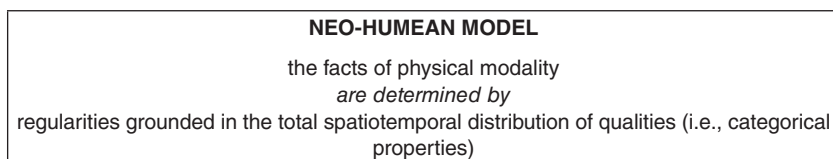


Figure 1.1 Neo-Humean Model of physical modality

Further clarifying the commitments of Humean Supervenience, Vetter (2015: 7) explains that it excludes “modality – the whole modal package – from the supervenience base. The Humean world is, at root, thoroughly nonmodal.” This is what mainline Neo-Humeans are explicitly committed to. However, I will argue below that Humean Supervenience has a hidden feature that, when brought to light, implies powers. Before getting to that, I will consider some other possible criticisms.¹⁰

Criticisms of Neo-Humeanism

Several strategies are available to criticize Neo-Humeanism. First, one could try to show that the view is incoherent; however, I do not think this is viable. It is a well-developed, complete metaphysic refined through the work of several philosophers tracing back to Hume, with several advantages and disadvantages that must be weighed against other views of physical modality. This suggests a second strategy: Comparatively analyze Neo-Humeanism against the other models based on the merits/demerits of each. For example, one might argue that Neo-Humeanism does not explain some feature of reality as it appears to us or does not explain our epistemic practices regarding those appearances.

Cartwright (2017: 17), for instance, argues that we need to posit powers in scientific theories: On her view, the inclusion of causal powers in our ontological picture gives us greater predictive power; yet powers are not reducible to Humean qualities. Our best scientific theories, in other words, should quantify over causal powers. In any purported chain of inference

¹⁰ Vetter (2015: 8) suggests that Humean Supervenience goes against its principal proponent’s stated aim “to resist philosophical arguments that there are more things in heaven and earth than physics has dreamt of” (Lewis 1994: 474) because physics says nothing “about any ‘underlying’ qualities or quiddities” (as well as, we might add, an infinity of genuinely real possible worlds). Without Humean Supervenience, says Vetter (2015: 9), the motivation for possible worlds realism also takes a hit. By contrast, because the Pure Powers Model eschews underlying qualities, it might more closely align with science’s functionalist and operationalist tendencies; however, see Williams (2011) for a critique of the argument from science for pure powers.

for empirical predictions, “Powers [...] have to be there in the facts that we input at the very start or our derivations will not lead us to true results” (2017: 19). The problem with this argument is that there will probably always be a way for the Neo-Humean to add in one more fact or contingent relation between the facts to show that their view has equal predictive and explanatory power, that is, epistemic ability to explain the modal features of reality. Although this might increase the complexity of their position, so long as Neo-Humeans can accommodate all the essential behavior of what others will argue emanates from causal powers, the Neo-Humean Model will have equal epistemic force. However, it must be noted that an ontology of real causal powers can ground physical modality, since powers metaphysically explain modal features: Indeed, powers are inherently modal properties, whereas the qualities on Humean views are not.

In general, I worry that all three models of physical modality are internally consistent, can be made compatible (given plausible modifications) with the empirical data, and have equal predictive power.¹¹ That is to say, this is a genuine metaphysical debate concerning the way the world is beyond the empirical appearances. The criteria to employ in navigating such a debate include simplicity or parsimony, elegance, and logical fit with other accepted theories. But what if one could show that Neo-Humeanism (or another target view) has a metaphysical feature previously unrecognized by its proponents, which completely transforms the kind of view it is? I wish to contend – primarily based on the work of Cross (2012) and Strawson (2008) – that Neo-Humeanism cannot escape the ontology of powers: Powers and their modality are subtly inherent in the Neo-Humean Model, particularly Humean Supervenience.

How Neo-Humeanism Implies Powers

Cross (2012) argues that Lewis’ Humean Supervenience – although it explicitly eschews powers and necessary connections between spatiotemporal events – requires powers. Lewis adheres to the view that properties “endow *different* powers in *different* circumstances” (Cross 2012: 136). But Cross contends that these circumstances – global, nomological

¹¹ So, I do not hold, as Harré and Madden (1975: 1) do, that “There can be no doubt that the Humean conception of Causality and its linear descendant, the Regularity Theory, must be wrong.” I take them to imply that Neo-Humean views are also undoubtedly false. Although I agree in general with them that there are real causal powers, and that there are good reasons to accept causal powers and deny Humeanism, my level of confidence in (or against) metaphysical theories stops short of certainty. Perhaps they were exaggerating when they opined “no doubt.”

circumstances – effectively function as activation conditions for the (supposedly qualitative) properties endowing the objects that bear those properties with powers. As such, these supposed qualities are actually powers. Therefore, Lewis implicitly posits powers in his fundamental ontology.

The central insight in this argument is that the Humean laws of nature – global states or conditions – can be interpreted as conditions of manifestation for the point-like (and supposedly qualitative) properties in the Humean supervenience base. The global conditions, in a sense, “trigger” or “stimulate” these properties to reveal different potentialities. This is analogous to how the immersion of NaCl in water causes its dissolution and the striking of a match causes flame. On a (much) larger scale, “the laws of nature reveal the causal powers inherent in so-called categorical properties [qualities]” (Cross 2012: 142).¹² It is important, however, to note that the global conditions that reveal different potentialities of properties are not exactly triggering events or stimuli in the typical sense as, for example, in the striking of match. Nonetheless, natural properties are differently disposed in different worlds and the only difference in these worlds is the sequencing of events or regularities – that is, the global conditions.

In support of this claim, powers can have what is known as *alien sensitivity*: “radically nonactual” activation or triggering conditions that could subject them to manifestations that they would not ever undergo in the actual world (Cross 2012: 136). It is possible for our world to contain properties with effects capable of manifesting “only in the company of an alien” property (2012: 135). For example, there could be two particles that never, in fact, meet, but if they did, they would produce a new kind of particle with alien properties and powers (Martin 1993: 180, 1997: 224–226). We can also imagine exotic triggering conditions like a deity’s predilections toward ensuring a vase breaks if even a lone dust particle touches it.¹³

Recognizing that some properties only reveal their powers under alien circumstances (triggers that are not part of the actual world but, if they were, could cause an actual-world property to manifest) brings us to the

¹² However, there is a disanalogous component: salt and water are powerful partners for specific token effects, whereas laws and properties are not powerful partners for specific token effects, but for the actualization of different powers than the property in question would otherwise have. Yet, there is a strong similarity with powers that remain actively manifesting when certain environmental conditions are satisfied. For example, arguably the mass of fundamental particles is generated by immersion in the Higgs field: as such, mass is a causal power that a particle obtains in virtue of total environmental conditions (Bauer 2011).

¹³ The triggering property could be an “alien” property, and the manifested property – a new power – could also be an “alien” property, wholly foreign to this world, with no chance of manifesting because its partner is an alien property.

point of recognizing that the properties in Lewis' supervenience base are tantamount to powers. On Lewis' view, there certainly are "possible conditions such that" some property "F endows some power to objects in those conditions" (Cross 2012: 140). More specifically, there are global conditions – that is, some parts of the pluriverse – that trigger the Humean base properties to gain some powers different than they actually have.¹⁴ Different laws activate different powers. While Lewis might not exactly hold this nomic theory of powers, Lewis' view is close enough to it and, besides, the point is that "there *are* possible conditions in which F disposes things to become Gs" (2012: 136). It is for these reasons that Cross (2012: 140) claims that "categorical properties [qualities], far from the inert, modally innocent creatures they purport to be, are in some sense *modal monads*, representing the full range of possible conditions (but unlike monads, causally interacting as well)." These modal monads are virtually indistinguishable from powers, directed toward various outcomes conditional upon appropriate global conditions.

This is a surprising interpretation of Humean Supervenience and not how Lewis himself sees things. *But it is surprisingly close.* Cross envisions a counterpart Lewis – "DLewis." Lewis and DLewis agree on nearly every count – the existence of discrete, spatiotemporally separate, concrete possible worlds; counterpart theory; and properties as sets of possibilia. However, they disagree on one point: DLewis thinks fundamental properties (those in the supervenience base) are powers, not qualities. He accepts what Lewis denies: that the global states are conditions that "endow the powers [in the base] to bring about" effects or manifestations (Cross 2012: 144). Both DLewis' and Lewis' metaphysics are coherent, and the view of properties is only "nominally different" (2012: 145). There are no differences in the behavioral modality of properties – it is just a different *interpretation* of Lewis' own fundamental metaphysical premises.¹⁵

¹⁴ The manifestation here is not like a glass breaking, but the glass gaining the ability to break; the potential for gaining a power is itself a power. In other words, the type of manifestation Cross seems to have in mind is the *gaining* of a power: *x* manifests its ability to gain a power, a power which can then be triggered by global conditions.

¹⁵ If Humean Supervenience is a contingent thesis (Lewis 1986a: x–xi), then it is true only in a limited range of possible worlds including the actual world: worlds "Within the inner sphere of possibility" and without "alien" properties (1986a: x). (Comparing this remark about "alien" properties to the discussion of alien sensitivity in an earlier paragraph – while keeping in mind that Cross' argument invokes alien sensitivity – it is worth noting that despite the limited range of worlds of which Humean Supervenience is true, Lewis does allow alien triggers, such as sorcerers [Lewis 1997: 147–148].) Thus, Cross' DLewis argument applies only to worlds in which Humean Supervenience holds. Still, this should be a large range of worlds with plenty of opportunities for the fundamental

To resist, Lewis would have to agree with DLewis on every point while refusing to label as a *power* that which behaves like a power (Cross 2012: 145). In this way, given the total package of Lewis' metaphysics and the observation that the properties in the base behave as powers, Lewis not only could, but reasonably *should*, accept DLewis' view. Lewis and DLewis do not have different ontologies but different interpretations of one and the same ontology.¹⁶ Lewis might well have said, "there is just one little disposition and then another" (2012: 141) in place of "just one little thing and then another" (Lewis 1986a: ix), where things are "local qualities" (1986a: x).

In further support of the DLewisian interpretation, consider that in Lewis' pixel or computer screen metaphor (Lewis 1986a: 14), pixels are akin to qualities, independent of each other and capable of instantiating a vast range of colors (nearly 16.8 million, of which humans can only detect 10 million), such that any distribution of colors across the screen can be completely rearranged with different programming.¹⁷ On DLewis' interpretation, each pixel can be interpreted as modally rich: Each is packed with potential for a variety of outcomes, contingent on global conditions. Changing global conditions is akin to reprogramming the pixels.

Strawson (2008: 277) also develops a powers-oriented interpretation of Neo-Humeanism. His interpretation is, in some ways, a more general critique of Neo-Humeanism than Cross' targeting of Lewis' brand of Neo-Humeanism. Strawson argues that the powers of any object, *x*, include its

properties to have their world-relative powers activated (i.e., to become specific powers) owing to global conditions at that world. I further note that if Humean Supervenience really is a contingent thesis, then it would seem that in some worlds there are inherent, irreducible powers (i.e., dispositional essentialism appears to be true in those worlds). So, setting DLewis aside, Lewis himself must be open to the possibility of irreducible powers. So, for example, in some worlds charge is a quality with contingent powers, but in other worlds, charge is an irreducible power. This makes it curious as to how, if one has empiricist leanings, we could know which kind of world we are in: a powers- or qualities-based world.

¹⁶ In further support of the DLewis interpretation, assume that properties are sets of individuals (Lewis 1986b: 50). So, a property is a set of objects not just in the actual world but across some range of possible worlds; for example, electric charge is the set of all electrons carrying charge, whether in this world or others. But what charge *does* – its causal role – differs across worlds owing to different regularities in the patterns of events. So, as a property (i.e., a set of individuals), charge (or any other natural property) has the power to manifest differently in worlds with different laws. It might be that each *instance* (borne by each particular) does not have the power to be a different power (though it does have the power to obtain the actual causal role in each world that it in fact has), for then it would be a different instance in a different world. However, properties – taken as sets of individuals, as Lewis does – do seem to have the power that Cross ascribes to them: to have different powers in their different instances across worlds. That is, DLewis is correct.

¹⁷ Lewis specifically tells the analogy in terms of a "dot-matrix picture" with "dots" and "non-dots," but Schrenk (2017: 76) helpfully frames the example in terms of computer screens and pixels.

powers to behave differently under different laws. Even if we suppose that laws can come apart from the (categorical) nature of matter – as the Neo-Humean maintains¹⁸ – Strawson (2008: 277) thinks we cannot justifiably claim that x 's "fundamental dispositions [powers] will change on change of nomic environment" as Neo-Humeans maintain. This is because the fundamental powers of x include the power to behave in different ways in different nomic environments or contexts (i.e., worlds with different orderings of events, per the regularity theory of laws). In nomic environment 1, x has the power to behave in way M₁; in nomic environment 2, x has the power to behave in way M₂; and so on. That is, objects have powers to gain (have activated) new sets of powers under different laws.¹⁹ This is basically the DLewisian view discussed above.²⁰ The intrinsic qualities of the Humean mosaic are, in short, "meta-powers" (powers to gain powers) because the specific causal roles that they have in different worlds are determinable by global conditions.²¹ By contrast, nonmeta-powers – of the kind on the Powers Model to be discussed in Section 1.4 – just are the powers that they are (see Figure 1.2).

We can illuminate the idea that Neo-Humeanism implies that qualities are meta-powers (and therefore powers) by focusing on the quality/power distinction. Suppose we differentiate qualities and powers in terms of manifestations. Then powers are not always manifesting; they can remain latent. However, qualities *are* always manifesting; specifically, they are manifesting their meta-power to have certain world-specific, nomologically contingent powers.²² Qualities are manifest under all conditions in

¹⁸ Strawson (2008: 277) rejects what he calls the "separatist' habit of thought," which, as I understand it, is how he thinks the Humean approaches metaphysics, and according to which laws should be conceived as linguistic, human creations. By contrast, laws are to be understood "as non-linguistic objective principles" and cannot be independent of the categorical (=dispositional) nature of matter (Strawson 2008: 277).

¹⁹ This supports Strawson's overall argument that qualities and powers are inseparable, and in fact identical to each other. However, in accepting the claim that objects have powers to behave in different ways under different laws, I argue that the identity theory is not forced on us; for we can deny the identity claim by contending that powers are devoid of quality (more on pure powers in Section 1.4).

²⁰ The power does not lie with the laws, for according to Humean Supervenience the laws are simply regularities; therefore, the power should be found in the only "real" things on this view: the properties of spacetime points.

²¹ Broad (1925: 432–433) distinguishes first-, second-, and higher-order powers, where the latter are powers to gain or lose lower-order powers; see McKittrick (2018: 9) for discussion. On the interpretation I am putting forward, Neo-Humean qualities have higher-order powers to gain new powers in different nomic situations (worlds).

²² Hüttemann (2009: 225) holds that while instances of dispositions are "*manifest under specific conditions only*," categorical properties are "*manifest under all conditions*"; thus, "categorical properties are limiting cases of dispositional properties" – as such the distinction between property and

that their meta-power is always activated relative to some world; although they might not always be doing what they are activated for in a world w , they are always activated to have specific powers in w .

	Qualities	Powers
Property F has a meta-power to <i>gain</i> power to ϕ	Necessarily have power to gain world-specific, law-dependent powers to ϕ	No meta-powers; have law-independent modal natures
Property F has power to ϕ	Contingently have power to ϕ	Necessarily have power to ϕ

Figure 1.2 Powers and meta-powers of qualities versus powers (ϕ is a manifestation type)

Livanios (2017b: 34) observes that Strawson ascribes to “properties either a transworld *functional* essence or the same *total* essence, *part of* which is instantiated in each possible world.” This, he contends, is unorthodox because usually powers theorists maintain that a power presents its whole essence (not necessarily all of its actual *manifestations*, of course) in the world in which it exists or is instantiated. However, I do not think the unusualness of this claim presents a significant worry. This is because, on Strawson’s interpretation of Neo-Humeanism, each power’s total essence (its total causal profile) remains fully present in each nomic context; but the specific laws (and nonlaws) in each nomic context effectively *mask* part of each power’s essence. As such, a power will only be capable of manifesting a subset of its full range of power upon a shift in nomic context. It is important to not overlook that this point assumes that the presence of nomic contexts is indeed relevant to modality, something powers theorists typically reject. But if powers theorists were to accept such nomic contexts, adopting a Neo-Humean view of laws while maintaining a powers view of properties, then, surely, they would correspondingly adjust the essence of powers so that each power’s total essence would include its essence in different possible worlds/nomic contexts. They would accept a meta-view of powers. That is, they would accept that, from the point of view of particular nomic contexts, each power’s potency (essence) is only partially in play, whereas normally they hold that all of a power’s potency (essence) is in play in the world in which it exists. Nonetheless, on both views, each power has or embodies its full essence – the power it inherently has despite the nomic context masking some of that power.

manifestation “doesn’t do any work.” However, I disagree that it does no work; for the limiting case – *necessary* manifestations that signify categoricalness – is distinct from the *contingent* manifestations of dispositions.

Given that the supervenience base qualities are conceived only as conferring powers to objects in virtue of the laws of nature, they are in a sense mere intermediaries or “transit centers” for powers and their displays. But in having this primitive role, I claim – invoking Cross’ and Strawson’s arguments – that they do have powers: they must have the power to take on different causal roles, to be adaptable to different nomic environments. In other words, if quiddities can swap causal roles (Bird 2007a: 73–76) in different nomic environments, they must be capable of world-specific modal reprogramming; if they were truly *completely inert*, they could not and would not serve any modal role.

Responses to the Powers Interpretation of Neo-Humeanism

One objection is that in extracting powers from the innards of the Neo-Humean Model, we are adopting the mystery of powers – supposed by some as occult, unobservable entities – in place of the more empirically oriented, mystery-less mosaic of particular facts. However, there is also great metaphysical mystery in the Neo-Humean Model. This is because it allows that “anything can be the cause of anything” – in one world hammer strikes *break* vases, while in another world they *liquefy* them – therefore, the Neo-Humean Model “involves an occult, even mystical, conception of the world’s unfolding” (Campbell 1990: 116). This runs contrary, notes Campbell, to a scientific conception of the world in which scientists often frame happenings in terms of forces, powers, and the like to emphasize causal relations and interconnectedness. The point is not that the Powers Model presents no mystery (i.e., no unexplained features). No serious, complete conception of reality is free of that accusation. Rather, the Neo-Humean Model is no less mysterious, thus not on more secure grounds, than the Powers Model. This sense of mystery is exacerbated by the fact that qualities are supposed to be quiddities with an inherently unspecified this-ness that does not “prescribe anything” (Schrenk 2017: 73).

Another objection is that the powers-oriented Dlewisian interpretation of Neo-Humeanism appears to be less parsimonious than the qualities-oriented Lewisian interpretation. This is because, beyond qualities, the Humean mosaic of properties is supposed to contain only spatiotemporal relations. Everything that exists – including all ordinary “objects” within our experience – is supposed to be reducibly explainable in terms of the mosaics’ qualities and their spatiotemporal relations (Lewis 1986a: ix–x).²³

²³ See Nolan (2014: 34–38) for an illuminating discussion.

However, if the properties that make up the fabric of the Humean mosaic are powers, not qualities, then on networking accounts of powers the mosaic would need to also include stimulus and manifestation relations (e.g., as part of the identity conditions of a power). If these relations are added to the supervenience base, then things look less parsimonious than with the qualities-only view.

One way to respond is to argue that stimulus and manifestation relations are not fundamental: they arise from the mosaic of powers and their spatiotemporal relations. It seems that potential manifestations (i.e., potentialities for effects, including the stimulation of other powers) are inherently part of the identity and essence of powers – supposing, as seems reasonable, every power is a potentiality (Vetter 2015: 19). Therefore, the potency of powers is irreducible and part of what it means to be a power. Therefore, importantly, it is not the manifestations that need to be added to the fundamental picture of reality – only the *potential* for such. What I ultimately suggest is that each power inherently contains information about its directedness toward and possible interactions with other powers, and thus about its potential manifestations. Actual manifestations might be relational, produced by the relationality between two or more powers; but the information that drives powers toward these manifestations is not. (These claims will be developed in Part II.) This information is the source of the specific directedness that each power has toward its possible manifestations, and this is neither more mysterious nor less parsimonious than the hidden, haecceity-like essence that qualities have. The inherent nature of each power explains why powers do what they do.

The argument of this section strongly suggests but does not prove that Neo-Humeanism – in particular, Lewis' Humean Supervenience thesis – implies that properties are powers, contrary to the wishes of its adherents. This favors the Powers Model. However, could there be something short of powers but non-Neo-Humean in character that explains physical modality, perhaps a primitive necessary connection between properties? Enter the Universals Model.

1.3 The Universals Model Needs Powers

Some theories of laws of nature are best characterized as descriptive – in particular the regularity theory of laws that is part of the Neo-Humean package – whereas others are prescriptive such as necessitarian theories of laws (Dumsday 2019: 3). On the Universals Model, a necessitarian theory, prescriptive power comes from universals governing the order of events.

The Universals Model says that a law of nature is a necessitation relation, N , that holds between two universals, F and G , understood as categorical properties or nonpowerful qualities: $N[F,G]$.²⁴ N is a nonlogical, contingent necessitation relation (Armstrong 1983: 71–102), thus representing physical modality, not metaphysical or logical modality. For any particular a that is F , a will be G , provided that $N[F,G]$ holds. $N[F,G]$ undergirds all kinds of laws of nature; for instance, F could be an electron e_1 's negative charge, and G the repulsion of e_1 when approaching a second electron e_2 .

However, it is important to note that just because some particular possesses F does not mean that the law $N[F,G]$ holds. The entailment goes from the general *law* to the instantiated *state of affairs*, not from the instantiation of F and G to the law $N[F,G]$. This is reflected in the metaphorical idea that laws of nature “govern particular states of affairs” (Armstrong 1983: 98).²⁵ Owing to the law represented by $N[F,G]$, the Universals Model is an account of physical modality (see Figure 1.3).

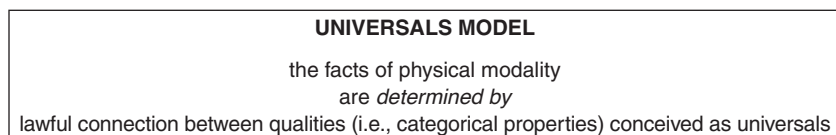


Figure 1.3 Universals Model of physical modality

Borghini and Williams (2008: 35) ask, “What is the modal power inside a natural law?”²⁶ This is a revealing question for any account of laws of nature, especially the Universals Model. For this model posits laws as real, mind-independent entities that govern relations between objects, thus explaining physical modality. The model makes a law an *entity* (in the

²⁴ I focus on the view as formulated by Armstrong (1978, 1983), who calls it the Universals theory. A statement of the general idea can be found in Armstrong (1983: 83). Armstrong (1993: 422) has clarified that on his account N is a causal relation. Dretske (1977) presents a similar account, although his argument is conditional: *if* there are laws, they are relations between universals (1977: 267). Tooley (1977) also presents a universals-based account of modality, but for him universals are transcendent, unlike for Armstrong, who maintains that universals are immanent.

²⁵ The claim that laws govern holds significant sway in our thinking about the nature of reality (Roberts 2008: 1–5). However, it is metaphorical owing to the “imperfect analogy between social law and law of nature” (Armstrong 1983: 106). Yet it captures the idea that laws stand independently from their instantiations. By contrast, Armstrong notes, the regularity theory of laws (taken in section 1.2 as part of the Neo-Humean Model) cannot make sense of either the governing metaphor or of laws being independent of their instantiations.

²⁶ By “natural law” they mean “law of nature” (laws as in science, not in Thomism).

broadest sense of the term “entity,” an existent of some sort) that affects the world. The lawfulness is found in N. But what does N do? On one hand, if N is utterly passive, incapable of producing change, then F would not be G due to N itself. On the other hand, if N is supposed to do something, then it *is* productive, implying modal force or power.

In this light, Barker (2013: 621) contends that the Universals Model (the second degree) seems to require a power-like necessary connection between properties, or it collapses into brute-modalism (the first degree, i.e., Neo-Humeanism). He continues:

If there is to be a second degree at all, then second-order facts like $N[F,G]$ have to *constrain* or *govern* first-order facts of natural property instantiation. But [...] that requires that $N[F,G]$ necessitates lower order facts *by virtue of the inherent nature* of N. But this means N has to be powerful in a way analogous to the third-degreeer’s powerful natural properties.²⁷ (Barker 2013: 621)

The necessity between F and G cannot be a brute relation (2013: 617). If it were brute, it would be a brute fact about possible worlds – where “all Fs are Gs” is simply correlated with $N[F,G]$ – and $N[F,G]$ would not be the source of the necessity. In that case, we would be back to the Neo-Humean Model discussed in Section 1.2 (Lewis, not DLewis). However, on the Universals Model, the necessity between F and G is due to an inherent necessity relation, N. Instead of being simply a brute fact, there is assumed to be an explanatory basis for “all Fs and Gs” as specified by $N[F,G]$ where necessity “just *flows* from the nature of N. It is a kind of second-order power” (2013: 618).²⁸ N is a power-like source of the necessity that transpires between F and G.

Perhaps the power that N implies is a power of the *system* of law-abiding properties as a whole (e.g., of the universe or nature as a whole). Still, this is a power. Power must be present somehow to effectuate the connection between F and G. According to the Powers Model, F and G would themselves be powers. But on the Universals Model, the power is removed one step from F and G and given the designator N. Present and real is the power of N, so much that F necessitates G.

In *A Treatise of Human Nature*, Hume (2002: Sect. XIV) lumps together various nomic concepts: “EFFICACY, AGENCY, POWER,

²⁷ The third degree is what I call the Powers Model.

²⁸ A similar conclusion must be drawn, I suggest, from antireductionist views of laws (such as Carroll 1994, 2008): that the fundamental, irreducible laws are powers of nature to enforce physical ordering and necessity between events in the universe.

FORCE, ENERGY, NECESSITY, CONNEXION, and PRODUCTIVE QUALITY, are all nearly synonymous; and therefore it is an absurdity to employ any of them in defining the rest.” If Hume is correct, consider what this means for Armstrong’s analysis of laws and properties. Given that Armstrong touts a *necessary connection between universals* under the governance of law, this could reasonably be interpreted as akin to a *power’s necessary manifestation under appropriate conditions*. In other words, the Universals Model and the Powers Model, on the face of it, have a lot more in common with each other than they do with the Neo-Humean Model. This implies that it is not a metaphysically big step from the Universals Model to the Powers Model.²⁹

In sum, maintaining that N is inherently powerful – or sufficiently power-like to believe that N is powerful – seems like the only viable position for a Universals Model proponent to take. Therefore, according to Barker (2013), since the Powers Model collapses into brute-modalism (i.e., Neo-Humeanism), the Universals Model also does because it too invokes powers. By contrast, I have argued that the Neo-Humean Model requires powers, so no such collapse into brute-modalism can in fact occur – any collapse of the Powers Model would be a collapse into some *alternative* powers model. Therefore, the question becomes: which of the three different, ultimately powers-based, models is best? I think the Powers Model (and specifically the Pure Powers Model) is preferable because it is more economical: It need not refer to governing laws or possible worlds in explaining physical modality, and it keeps modal action simpler than the other models by placing modality squarely inside properties.

Like the Neo-Humean Model, the Universals Model provides a coherent account of properties, laws, and physical modality. Although both models claim to be nonrealist about powers, if the arguments of Sections 1.2 and 1.3 are on the right track, then both models implicitly posit powers. I do not take the arguments in Sections 1.2 and 1.3 to be completely decisive. However, they raise significant suspicion that powers are subtly (or not so subtly) involved in these two models. Therefore, let us look at the Powers Model.

²⁹ Bird (2005) also argues that the Universals Model (any in the Dretske-Tooley-Armstrong family of views) implies powers. If N is to explain why there is a necessary relation between distinct properties F and G, there is nothing to prevent one from simply positing that F has a necessary connection to G (a power and its manifestation), thus assigning modal force to F, thus making it a powerful property. And McKittrick (2021: 288) reiterates something similar to Bird (2005) and Barker (2013): locating a necessitating universal inside some particular to explain its activity is arguably no different than saying that the particular has the power to do the action.

1.4 The Powers Model

The Neo-Humean and Universals Models try to expunge irreducible powers from their ontologies. However, positing powers is unavoidable. To the extent that these supposedly nonpowers models are successful, it is because they implicitly posit powers. A weaker conclusion would be that those models only contain hints of powers (e.g., N displays some but not all of the characteristics of power-hood). Although I favor the stronger conclusion – that the other models are implicitly committed to a robust conception of powers – the weaker conclusion nonetheless gives sufficient reason to take seriously the hypothesis that real powers play an essential role in physical modality.

In light of the finding that the nonpowers models actually need powers, I adopt the Powers Model of physical modality. But beyond the *need* for irreducible causal powers, the Powers Model also appears to be more economical and elegant than the Universals Model and the Neo-Humean Model. This is because the modality needed to drive events is built right into powers and thus there is no metaphysical requirement for laws of nature, although it remains plausible that laws of nature are epistemically useful in scientific practice.³⁰ Moreover, a metaphysics of science based on powers has the potential to inform a number of key issues in philosophy besides modality, including causation, agency, free will, epistemology, and normative theory.³¹ Although these ramifications are not my main concern, noticing them bolsters motivation for investigating powers from the inside.³²

³⁰ The Powers Model, however, is consistent with the metaphysical reality of laws (Bird 2007a; Dumsday 2019).

³¹ See Meincke (2020) for an overview concerning how powers relate to other philosophical issues.

³² Powers according to the Powers Model are what Azzano (2019) calls *robust powers*: irreducibly powerful properties. There are also, Azzano suggests, *weak powers* and *moderate powers*. Weak powers are “obtained” simply through disquoting a statement about some particular *x* being disposed: for example, if “the glass is fragile” or “the glass has the power to break” is true, then the glass has the power to break. However, weak powers assume no ontological posit to explain or ground the truth of the dispositional statement. Logical empiricists would tend to be mere weak powers realists for wanting to avoid any commitment to any kind of hidden metaphysical reality. Moderate powers – as found in the Universals Model and Neo-Humean Model – are properties that are “at least partially responsible [...] for dispositional truths” (Azzano 2019: 342). These are real properties that feature in nomic-causal explanations of events. But, sans laws of nature, they would lose their power. Thus, Armstrong and Lewis are moderate powers realists. One might reasonably contend that Armstrong – or Dretske or Tooley for that matter – are strongly moderate powers realists, whereas Neo-Humeans like Lewis are weakly moderate powers realists. Regardless, if the arguments I have presented above are on the right track, it is likely that proponents of moderate powers are actually committed to *robust* powers. Note that the third degree of realism specified by Azzano – robust powers – aligns with the third degree of modality as specified by Barker (2013).

Questions about the Powers Model

What do we accept in admitting irreducible powers into our ontology? Whereas qualities are perpetually manifest, powers reside in a state of real potential: they are real properties but their effects might not ever manifest. When triggered in the appropriate circumstances – with no interferences, finks, masks, and so on – powers will manifest: electrons will repel each other, fuel will explode, a fragile glass will break, a chocolate lover will eat chocolate.

The Powers Model can explain the same modal facts as the Universals and Neo-Humean Models but can do so more simply and elegantly by making properties inherently modal. The Powers Model combines the truthmaker for modality (a property) and the modal force (a power) – a powerful property just *is* the source of physical modality *and* that which is involved in modal relations. Thus, the Powers Model can eschew laws, unlike the other models, although it need not do so.³³ I am inclined to dismiss laws of nature as real, mind-independent things. Given a fully developed theory of powers, according to which powers are the modal force in the universe, we have enough to account for the cosmos' dynamic nature. However, law statements – as equations or summaries of what could happen – remain useful to scientific practice and everyday reasoning.

Despite advantages in elegance and simplicity, a problem haunts the Powers Model. What are powers like from the inside? If they are modal entities, as presumed, then exactly what about them explains their modality?³⁴ Is there anything further that we can discern about their internality

³³ Although powers theorists tend to eschew laws, holding that powers are the drivers of activity in the universe, recently some powers theorists have been advancing alternative accounts. These accounts attempt to show how the Powers Model is compatible with a robust, realist sense of laws (Dummsday 2019; Tugby 2016), contrary to eliminativist accounts (Mumford 2004) or weakly realist, supervenience accounts of laws (Bird 2007a) advanced by other powers theorists. For example, Dummsday (2019: 9–22) presents what I interpret as a middle ground between the Universals Model and the Powers Model of modality. He argues for a dispositionalist theory of governing laws according to which instantiated powers (conceived as universals) and uninstantiated universals – as specified in *ceteris paribus* clauses, which are necessary to the identity conditions of powers, according to Dummsday – conjointly underpin physical modality. These uninstantiated universals fit the bill for lawhood because “with them we have abstracta determining that certain events can or cannot take place under particular circumstances” (2019: 14). My suspicion is that these uninstantiated universals are still properties doing “powers work” along with the instantiated powers, so it is not fundamentally different from the Powers Model.

³⁴ It should not go unnoticed that the internal nature of quiddities (categorical properties or pure qualities) also remains something of a mystery. They have something of an ineffable “this-ness” apart from their merely contingent causal roles and relations to other properties.

other than that they are modally charged? Much of the discussion of powers has focused on their relationality in the form of networking accounts, as discussed in Section 0.7. But I contend that the nature of a power – what it is to be a power – is *not* fully revealed by examining its causal role in a system of powers. Their networked nature is important, and much of what I want to argue overlaps with this idea, but I think we can discern more about a power’s internality.

What we would like to discern is a power’s point of view, so to speak. Although the true internal nature of any entity – other than, perhaps, some aspects of our own minds – might forever be occluded from us, this should not stop us from offering careful interpretations of entities in the world that include hypotheses about their internal natures. Speaking of powers (and properties in general) from the “inside” is somewhat metaphorical. The term “inside” implies a boundary or spatial containment that could be misleading. What we are after is to understand their nature, to get a picture of their internal setup – the way powers are “through and through” beyond their relations to each other and things in the world.

Varieties of the Powers Model

There are two primary ways to build the Powers Model: powers as *pure*, or powers as simultaneously *qualitative*. Pure powers have no qualitative nature, whereas powerful qualities are simultaneously powerful and qualitative (see Figure 1.4).

POWERS MODEL	
the facts of physical modality <i>are determined by</i> the potentiality of powers (i.e., powerful properties)	
Pure Powers Model	Powerful Qualities Model
properties are entirely powerful and have no qualitative nature whatsoever	properties are simultaneously (P) powerful and (Q) qualitative
Scope of Pure Powers Model pandispositionalism dispositional monism dispositional essentialism	Compound View (P + Q) P and Q are “parts” or aspects of a property Identity View (P = Q) P is numerically identical to Q

Figure 1.4 Variations of the Powers Model of physical modality

The Pure Powers Model claims that properties – at least some, but perhaps all – are entirely and essentially powerful.³⁵ This does not mean that they are mere potentials; pure powers are real, actual properties capable of manifesting when triggered in relevant conditions. A pure power’s identity conditions consist of its causal profile – its range of possible causal effects within a variety of circumstances. By contrast, the Powerful Qualities Model combines quality and power into a single property.³⁶ Importantly, there are two ways to build the Powerful Qualities Model, as Figure 1.4 indicates: the Identity View and the Compound View. The Identity View says that properties are identical to both power and quality, that is, $P = Q$. Some might wish to characterize this view as a triple identity between *property*, *power*, and *quality* (Heil 2003: 111; Livianos 2017b: 31). However, since each of the latter two (power, quality) just are *property* types, the triple identity seems redundant. By contrast, according to the Compound View, powerful qualities are compounded of power and quality, that is, $P + Q$, such that P and Q are each “parts” of a whole property.³⁷ I will focus my assessment (in Chapter 2) on the Identity View mostly because the Compound View implies that one property is two properties, so it is *prima facie* incoherent.

What I call the scope of the Pure Powers Model, in the lower left box of Figure 1.4, concerns whether the model is interpreted to apply to all properties or just some subset of properties. The main options are pandispositionalism (all properties are pure powers), dispositional monism (all

³⁵ Advocates of pure powers, to varying extents, include Bird (2007a), Ellis (2001, 2002), Molnar (2003), Mumford and Anjum (2011), Anjum and Mumford (2018), and Shoemaker (1980), among others. Some (e.g., Bird) are dispositional monists, some (e.g., Mumford, Anjum) are pandispositionalists, and some (e.g., Ellis, Molnar) accept a mixed view (according to which some fundamental properties are powers and some, such as locations, are qualities). On the mixed view, Ellis (2010b: 105), for instance, maintains that fundamental categorical properties can play causal roles but only accidentally, not essentially.

³⁶ Advocates of powerful qualities – the Identity View, in particular – include Heil (2003, 2010, 2012), Ingthorsson (2013), Jacobs (2011), Jaworski (2016: 53–79), and Martin (2008), among others.

³⁷ Barker (2013: 622–623) classifies the pure powers and powerful qualities views as the two principal ways to interpret the Powers Model. However, he thinks that the identity version ($P = Q$) of powerful qualities is incoherent (2013: 649). That remains to be seen – powerful qualities are discussed in more detail in Chapter 2 – but for Barker (2013: 623) the real competition is between pure powers and the compound version ($P + Q$) of powerful qualities, according to which qualities “generate or produce modality.” He identifies three ways to construct pure powers (2013: 623): (i) relational constitution (the identity of powers – which are bundles of relations – is fixed by higher-order relations), (ii) graphs (powers are “nodes in a graph, whose *arc* is a modal relation”), and (iii) functional roles (powers are essentially functional properties). Barker criticizes the $P + Q$ version of powerful qualities (2013: 644–648) as well as the three understandings of pure powers (2013: 623–644). If my arguments in sections 1.2 and 1.3 are on the right track, then we must admit powers into our ontology as an explanation of physical modality.

fundamental properties are pure powers), and dispositional essentialism (some fundamental properties are pure powers). If one adopted dispositional monism, for instance, one would accept the Pure Powers Model for all fundamental properties but then accept that all nonfundamental properties are qualities or perhaps powerful qualities. If one accepted dispositional essentialism, one could take locations and spatiotemporal relations, for example, as qualities or powerful qualities, while asserting that all other fundamental properties are pure powers (thus accepting a limited scope of the Pure Powers Model). So, in general, one might maintain that pure powers, powerful qualities, and pure qualities are not mutually exclusive, thus that the correct view is a mixed view: taking any two or three of these models as true for different subsets of properties.³⁸

I accept the Pure Powers Model conceived strictly to exclude the other models, that is, conceived as pandispositionalism. If others do not want to accept pure powers to the maximum extent, they could still accept my major claims as applied to the pure powers that *are* posited in their ontologies. So, one could accept my major claims without committing exclusively to the Pure Powers Model.

Before further distinguishing these models of powers as well as critiquing the Identity View in Chapter 2, I want to introduce another aspect of the debate over physical modality and powers. Beyond the standard dual modality of necessity and possibility, Mumford and Anjum (2011) and Anjum and Mumford (2018) argue for a third, unique modality: the dispositional (or powerful) modality. Anjum and Mumford (2018) advocate the powers view of reality, arguing that it provides the foundation for properly understanding several metaphysical issues, such as the nature of

³⁸ To explain further, the various Powers Models presented here could be combined in various ways. For instance, one could hold that all fundamental powers are pure powers (the Pure Powers Model applies comprehensively), or that some fundamental powers are pure powers while some are powerful qualities (Pure Powers Model + the Powerful Qualities Model), or that some fundamental properties are pure powers while some are pure qualities as on standard “mixed views” of properties. Similar kinds of mixed views could be claimed for nonfundamental powers as well. In summary, one could have an *exclusive* or a *nonexclusive* interpretation of any of the Powers Models (or, for that matter, models that posit pure qualities). However, the simplest and most unified interpretation would exclude the other models, and that is how I proceed in this book in defending the Pure Powers Model. This Pure Powers Model, interpreted in an exclusive manner, is synonymous with pandispositionalism. However, all my central claims about the nature of powers (Chapters 2–6) are about their internal nature and thus do not require accepting pure powers to the exclusion of other models. Any theorist who accepts a mixed view could accept my claims about the nature of pure powers while holding that other types of property instances have their own nature. I will further discuss mixed views in Chapter 7 and explore how a pure powers theorist might accommodate the appearance of qualities at higher levels of reality.

causation. But they think that the standard approach to thinking about modality in terms of either necessity or possibility is insufficient to capture the true nature of powers: powers *tend* toward their manifestations, without necessitating them while yet being more than merely possible. The dispositional modality is something “less” than necessity (be it metaphysical or physical necessity) and something “more” than mere possibility. And a power’s tending toward its outcome cannot be reduced to probability; for Anjum and Mumford, tendencies (dispositional modalities) underlie probabilities.

In this chapter, I did not concern myself with the dispositional modality. As compelling as the idea might be to some, it is (at least) not yet widely accepted and needs further evaluation. In this initial dialectical context, it would beg the question against the first two models (the Neo-Humean and Universals Models) to assume that a dispositional modality must be taken on board. Moreover, the main theses about powers in this book can be maintained whether there is a genuine dispositional modality or not. Indeed, I think that one can be a realist about powers without accepting a unique dispositional modality if, for example, physical modality is explained by an informational structure within powers concerning only possibility and necessity – a point I will argue for in Chapter 6.