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CAUSAL POWERS, FORCES, AND SUPERDUPERVENIENCE

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Summary

Horgan (1993) proposed that "superdupervenience" – supervenience preserving physicalistic acceptability – is a matter of robust explanation. I argued against him (1999) that (as nearly all physicalist and emergentist accounts reflect) superdupervenience is a matter of *Condition on Causal Powers* (CCP): every causal power bestowed by the supervenient property is identical with a causal power bestowed by its base property. Here I show that CCP is, as it stands, unsatisfactory, for on the usual understandings of causal power bestowal, it is trivially satisfied or falsified. I offer a revision of CCP which incorporates the evident fact that causal powers are grounded in fundamental forces.

I. *Superdupervenience:* Horgan's Constraint *vs*. Condition on Causal Powers

Terry Horgan, in "From Supervenience to Superdupervenience: Meeting the Demands of a Material World" (1993) noted, largely on historical grounds, that the standard accounts of the supervenience relation are too weak to support a physicalist metaphysics of properties. On the standard accounts, supervenience is merely a matter of property correlations, holding within or across regions or worlds. But such abstract characterizations do not distinguish physicalism from its rivals, as is indicated by the fact that emergentists (such as J. S. Mill, Samuel Alexander, C. Lloyd Morgan and C. D. Broad) as well as non-naturalists (such as G. E. Moore) thought that emergent and non-natural properties, respectively, supervened on "physical-

istically acceptable" properties.

Historical precedent aside, it's clear that even the strongest varieties of supervenience, in leaving open what dependency relation is responsible for the correlations at issue, fail to *guarantee* that properties supervening on physicalistically acceptable properties will also be physicalistically acceptable (that is, fail to preserve physicalistic acceptability). For example, non-naturalist Malebrancheans might maintain that God (for reasons that we must accept with "supernatural piety"), in the actual world, brings about the instantiation of certain non-physical properties whenever certain physicalistically acceptable base properties are instantiated; and moreover maintain, on grounds of God's constancy, that God does similarly in *every* possible world. And naturalist emergentists might maintain, on either philosophical or scientific grounds, that instantiations of certain physicalistically acceptable base properties are accompanied by instantiations of emergent properties in every possible world. For example, emergentists might hold, as a philosophical thesis, that properties are essentially individuated in terms of the laws of nature they enter into, such that the hypothesis that the requisite physicalistically acceptable base property is instantiated in a world presupposes, as a matter of law, the instantiation of the emergent property. Or emergentists might hold, as a scientific hypothesis, that there are various "holistic" constraints on what laws of nature may exist at a world, such that, again, any world in which the requisite physicalistically acceptable base property is instantiated is also a world where the emergent property is instantiated. Hence supervening even with metaphysical necessity on physicalistically acceptable properties is no guarantee of physicalistic acceptability; and it seems likely that for any (mere) property correlations that might be suggested, a story might be told about a relation satisfying these correlations, which fails to preserve physicalistic acceptability.[1]

1. Note that one might extend the supervenience relation in a variety of ways to address this issue. For example, one might introduce a notion of "conceptual" necessity (understood as a particular kind of metaphysical necessity), such that one property supervenes with conceptual necessity on another just in case (the concept associated with) the latter property's being instantiated entails (the con-

Horgan suggested, again largely on historical grounds, that physicalists could achieve the sought-after guarantee – hence, "superdupervenience" – by imposing the following constraint:

> *Horgan's Constraint*: Any genuinely physicalist metaphysics should countenance ontological inter-level supervenience connections only if they are robustly explainable in a physicalistically acceptable way. (1993, 563)

(To say that supervenience is *ontological* is to say that it is an objective relation between lower-order properties and facts and genuine, objective, higher-order properties and facts; to say that supervenience for a given mode of discourse is *robustly explainable* is to say that it is explainable as ontological.) Robust explanation involves explaining why the supervenient property has whatever characteristic features it has, given that the base property has certain characteristic features. For example, Horgan says, "Explaining why liquidity supervenes on certain micro-physical properties is essentially a matter of explaining why any quantity of stuff with these micro-physical properties will exhibit [the features characteristic of liquidity – tendency to flow, to assume the shape of its container, and so on]." (1993, 579) And Horgan motivates physicalists' imposing his constraint by noting that it was the absence of such robust explanations that fueled turn-of-the-century emergentist claims that chemical and biological properties were emergent from their micro-physical base properties, and the advent of such explanations that coincided with the decline of emergentism and the rise to prominence of physicalist accounts of scientific properties.

Historically supported as *Horgan's Constraint* may be, I argued (in "How Superduper does a Physicalist Supervenience Need to

cept associated with) the former property's being instantiated. This approach has problems of its own, however; for conceptual entailment of the sort envisioned is plausibly only a sufficient condition on physicalistic acceptability; and when taken as a necessary condition, the evident lack of the requisite entailments threatens to falsify physicalism in (too) short order. *Horgan's Constraint*, which we are about to consider, may be understood as an attempt to extend the supervenience relation so as to provide a necessary and sufficient criterion for preservation of physicalistic acceptability, that does not set the bar so high that physicalism is rendered immediately false (or, for that matter, immediately true).

Be?," 1999) that robust explanation is neither necessary nor sufficient for superdupervenience, for the central cases at issue between physicalists and their rivals (which are also the cases at which supervenience claims are usually directed). These are cases of what I call "same-subject necessitation," where the instantiation of a property Q in a subject necessitates, with at least nomological necessity, the instantiation of a property P in that same subject (as when, putting aside externalist considerations, the instantiation of one of my brain properties necessitates the instantiation of one of my mental properties; or, as per Horgan's example, as when the instantiation of a micro-structural physical property in some quantity of stuff necessitates the instantiation of liquidity in that quantity of stuff).[2] Instead of *Horgan's Constraint*, I claimed that the following condition is necessary and sufficient for superdupervenience:

> *Condition on Causal Powers*: Where property P is same-subject necessitated by property Q, each individual causal power bestowed by P is identical with a causal power bestowed by Q.

(To say that a property bestows a causal power is, roughly, to say that the property's being instantiated contributes to its bearer's having the power, in appropriate circumstances, to enter into causing some effect. I'll discuss causal power bestowal in more detail down the line.) I won't (for the most part) rehearse my arguments against *Horgan's Constraint* here. But let me say a bit about my arguments for *Condition on Causal Powers* being necessary and sufficient for superdupervenience, prior to going on to show why this condition doesn't, contrary to what I once believed, provide (as it stands) a successful basis for a physicalist metaphysics of same-subject necessitated properties.

I started by showing how physicalism and emergentism, in particular, are motivated by, and encode, two distinct responses to the

2. My use of the terminology of necessitation is intended as being potentially modally informative as regards the relation at issue in cases of same-subject necessitation, while remaining neutral as regards the many specific accounts – including (besides supervenience *simpliciter*) identity, determination, realization, causation, etc. – that have been given of this relation.

problem of mental causation.[3] This problem consists of two threats. First is the threat that mental properties systematically causally overdetermine the effects of the physical properties upon which (all relevant parties agree[4]) the instantiations of mental properties depend. Second is the threat (following quickly in the wake of the first) that the only way to avoid such overdetermination is to deny that mental properties are ever causally efficacious.

These threats of overdetermination and exclusion arise, first and foremost, in cases of same-subject necessitation. (Moreover, it's clear that the necessitated property needn't be mental for the threats to arise; hence the problem of mental causation is just a specific instance of what we might call the problem of "higher-order" causation.) Now, of the many responses one can make to these threats, two are particularly notable as providing the means of avoiding both threats (unlike epiphenomenalism and eliminativism, which avoid overdetermination while admitting exclusion; or parallelism, which avoids exclusion while admitting overdetermination). According to the first notable response, associated with non-eliminativist varieties (both reductive and non-reductive) of physicalism, each causal power bestowed by a same-subject necessitated property is *identical* with a causal power bestowed by its necessitating property. Overdetermination is thus avoided, and on at least some versions of physicalism, this identification of individual causal powers appears to be compatible with the necessitated property's being causally efficacious. (See my article for evidence that the majority of physicalist accounts encode the identification of causal powers just

3. Much of the upcoming discussion of emergentism would apply to non-naturalist supervenience-based accounts (appropriately interpreted), as well. As in my article, however, I'll focus on emergentism, taking my primary goal to be to investigate how physicalism might be distinguished from other *naturalist* supervenience-based accounts.

4. Note that not all parties to the physicalism/anti-physicalism debates accept this (what amounts to a) supervenience thesis; in particular, Cartesian substance dualists do not, and as a result do not obviously face the threats under discussion. Since (following Horgan) the goal of the present discussion is to distinguish physicalists from those of their rivals that *agree* that the mental supervenes on the physical, the present focus on the problem of mental causation (and the concomitant neglect of substance dualists) is appropriate.

mentioned, and for details regarding how certain non-reductive physicalist accounts, in particular, are well-situated to justifiably claim that some same-subject necessitated properties are nonetheless causally efficacious.) According to the second notable response, associated with emergentism, in at least some cases of same-subject necessitation the necessitated property bestows at least one new causal power – that is, a causal power that is *not* identical with any bestowed by its necessitating property. That is, in response to the threats of causal overdetermination and exclusion, physicalists assert, and emergentists deny, that the above *Condition on Causal Powers* holds.

(More precisely, what I just claimed is true if the condition is interpreted as involving the supposition, which Kim has dubbed "Alexander's Dictum," that real (non-eliminated) properties bestow at least one causal power. In particular, cases where the condition is satisfied on grounds of vacuity – that is, on grounds that the same-subject necessitated property P doesn't bestow *any* causal powers – are to be understood as implying that P is unreal, and hence to be eliminated (in a fashion compatible with eliminativist varieties of physicalism) as opposed to implying that P is real, but epiphenomenal (in some way at odds with physicalism). In my article, I followed physicalists and emergentists in assuming Alexander's Dictum, and hence didn't incorporate this assumption into the condition.)

I went on to argue that *Condition on Causal Powers* is what is at issue in superdupervenience, as well. For if P is emergent or non-natural, then P bestows a new (natural or non-natural) causal power. But if P is same-subject necessitated by a physicalistically acceptable property Q, then the holding of *Condition on Causal Powers* obviously rules these possibilities out. So, *Condition on Causal Powers* is sufficient for superdupervenience. Moreover, this condition appears to be necessary for superdupervenience, as well; for accounts of the relation at issue in cases of same-subject necessitation that fail to guarantee the condition's holding make room for these possibilities. We may, for example, diagnose the failure of supervenience relations to preserve physicalistic acceptability by reference to the fact that property correlations alone, no matter how strong, do not guarantee that each causal power bestowed by a

supervenient property is identical with a causal power bestowed by its base property.

Finally, to return to *Horgan's Constraint*, I argued that we didn't need robust explanation in order to establish, in a given case, that *Condition on Causal Powers* was met. Maybe such explanation would be required, if the only way to get a handle on the properties at issue was by reference to their definitive or characteristic features. But given that *Condition on Causal Powers* is what is really at issue as between physicalists and their traditional rivals, there is an obvious alternative: pick out properties by reference to their causal powers. One can then proceed, in whatever a priori or a posteriori ways are available, to determine whether each causal power bestowed by a given same-subject necessitated property is identical with a causal power bestowed by its necessitating property.

For these reasons, it seemed clear that satisfying *Condition on Causal Powers*, rather than satisfying *Horgan's Constraint*, was the key to superdupervenience – and indeed, the key to *any* acceptably physicalist account of the relation between same-subject necessitated properties. And this judgment was confirmed in the fact that (as previously noted) the vast majority and variety of physicalist accounts of the relation at issue in cases of same-subject necessitation are designed, implicitly or explicitly, so as to guarantee the satisfaction of *Condition on Causal Powers*. Similarly, the vast majority of emergentist accounts are explicit in holding that it is in virtue of bestowing a new causal power that a property is to be deemed emergent.

These general results show that *Condition on Causal Powers* is much more than a criterion that renders supervenience superduper. It also gives substantive content, which has too often been lacking in the literature, to the conception of "over and aboveness" at work in the basic physicalist thesis that all scientific properties are "nothing over and above" physical properties, and the basic emergentist thesis that at least *some* scientific properties are "something over and above" physical properties, as per

> *Causal Powers Over and Aboveness*: Where property P is same-subject necessitated by property Q, P is over and above Q just in case P bestows a new causal power – a causal power different from any causal power bestowed by Q.

(I prefer to use the terminology of "over and aboveness" instead of "emergence" in the present context, so as to allow for the possibility that some physical properties may be, in the relevant sense, over and above other physical properties. An emergent property is one that is over and above *any* physical properties.)

Or at least, it certainly *seemed* to be the case that *Condition on Causal Powers* gave content to the notion of over and aboveness at work in these accounts. I now think that I, along with the majority of physicalists and emergentists, have been wrong to think that this conception marks out, as it stands, the relevant distinction between their doctrines. As it turns out, on the most common understanding of when it is that a property bestows a causal power, *Condition on Causal Powers* cannot, in cases of same-subject necessitation, fail to be satisfied. Hence, on this understanding of causal power bestowal, physicalism turns out to be trivially true for the central cases at issue between physicalists and their supervenience-endorsing rivals. And on a natural revision of this understanding of bestowal, *Condition on Causal Powers* turns out to be trivially violated, given an uncontroversial assumption upon which the debating parties agree. Hence, on the revised understanding, physicalism turns out to be trivially false *simpliciter* (for a single case of "over and above- ness" will falsify the general physicalist thesis).

These triviality results make no sense of the continuing debate between physicalists and emergentists. I'll later explore what options exist for making sense of this debate. But first, let's establish the triviality results.

II. *What Is It For a Property to Bestow a Causal Power?*

As mentioned earlier, to say that a property bestows a causal power is roughly to say that the property's being instantiated contributes to its bearer's having the power, in appropriate circumstances, to enter into causing some effect. Sydney Shoemaker, for example, has said that "for something to have a power … is for it to be such that its presence in circumstances of a particular sort will have certain effects"(1980, 115); and he has filled this in as follows:

> A thing's having a power *simpliciter* is a matter of its being such that [that is, its instantiating a property such that] its being in certain circumstances, e.g., its being related in certain ways to other things of certain sorts, causes (or contributes to causing) certain effects. A thing has a *conditional* power if it is such that if it had certain properties it would have a certain power *simpliciter*, where those properties are not themselves sufficient to bestow that power *simpliciter*. So, for example, the property of being knife-shaped bestows on its possessor the conditional power of being able to cut wood if it is made of steel, and the conditional power of being able to cut butter if it is made of wood. (2000, 25)

As Shoemaker notes, we can distinguish two kinds of causal powers bestowed by a property P (powers *simpliciter*, and conditional causal powers), by reference to two kinds of circumstances (corresponding roughly to what intrinsic and relational properties, respectively, may be instantiated, along with P). As a benign simplifying measure, I will, in the upcoming account of bestowal, gloss the distinction between powers *simpliciter* and conditional powers (referring to both as "causal powers") by ignoring the distinction between these two sorts of circumstances. I will also elide talk of the bearers of property instances as causing or entering into causing instances of an effect type E, speaking instead of property instances causing or entering into causing such instances. This gives us the following preliminary account of when a property bestows a causal power:

> *Causal Powers Bestowal (preliminary)*: A property P bestows causal power C(K,E) just in case instances of P, in circumstances K, cause (or contribute to causing) instances of E, and the holding of K alone does not cause (or contribute to causing) instances of E.

Now, in order to apply this account, we must say what it is for a property instance to "cause (or contribute to causing)" an effect. On this score, the important thing to note is that, as per the "or contribute to causing" hedge, it is *not* required, in order that a property bestow a causal power, that the property instance be a *cause* of the effect. What Shoemaker and others require is only that the property be

causally relevant to the effect[5] (which means, since causes are in any case causally relevant, that the case where P is a cause is supererogatory in the analysis). This relevance is usually understood as being a matter of *nomological sufficiency* for an effect. (Here I'm assuming, again for simplicity and without harm, that causal laws are deterministic.) For example, this view can be extracted from certain of Jerry Fodor's remarks:

> Consider … the causal powers of your biceps and mind … Roughly, our biceps have the same causal powers if the following is true: for any thing x and any context C, if you can lift x in C, then so can I; and if I can lift x in C, then so can you. (1987, 35)

Filling in *Causal Powers Bestowal (preliminary)* with a requirement of nomological sufficiency results in

> *Causal Powers Bestowal (nomological sufficiency)*: A property P bestows a causal power C(K,E) just in case instances of P, in circumstances K, are nomologically sufficient for instances of E, and the holding of K alone is not nomologically sufficient for instances of E.

Any claim that a property instance is, in circumstances K, nomologically sufficient for an effect is supposed to be, at a minimum, a counterfactual-supporting generalization. This requirement is significantly weaker than those usually associated with a property instance's being a cause. For example, throughout *Psychosemantics,* Fodor refers repeatedly to the causal powers of mental properties, but in his appendix to that book states "I don't believe there are intentional mechanisms … While I'm prepared to sign on for counterfactual-supporting intentional generalizations, I balk at intentional causation." (1987, 140)

Following certain moves in the causation debates, causal power bestowal might also be understood as requiring not only that instances of property P be nomologically sufficient, but also that they be nomologically *necessary*, in the circumstances, for instances of E. This results in

5. Thanks to Eric Hiddleston for pointing this out to me.

Causal Powers Bestowal (nomological necessity): A property P bestows a causal power C(K,E) just in case instances of P, in circumstances K, are nomologically necessary and sufficient for instances of E, and the holding of K alone is not nomologically sufficient for instances of E.

A requirement of nomological necessity is a strong condition on P's bestowing a causal power, which requires that certain, other, counterfactual generalizations be in place. But like the requirement of nomological sufficiency, this condition could be met without P's being considered a cause of an effect.

In fact, it is generally agreed that causation cannot be analyzed in terms of nomological sufficiency and/or necessity, in the circumstances, for producing an effect. (See the introduction to Ernest Sosa and Michael Tooley 1993 for a discussion of various problems with such analyses.) Some philosophers think that these conditions are too weak to ensure that a property instantiation is a cause; and others may take the nomological necessity condition, in particular, to be too strong a requirement. There's no doubt that the question of how to analyze the causal relation is rife with controversy. But for the most part, discussions of causal power bestowal have been able to sidestep this controversy, due to its being widely presumed that causal power bestowal requires only causal relevance, which in turn is usually understood as involving nomological sufficiency (in the circumstances), and perhaps also nomological necessity (in the circumstances).

III. *The Triviality Results*

Causal Powers Bestowal (nomological sufficiency)

The first thing I want to show is that, in cases of same-subject necessitation, when causal power bestowal is understood in terms of *Causal Powers Bestowal (nomological sufficiency)*, *Condition on Causal Powers* is trivially (in the sense of: cannot fail to be) satisfied.

Suppose that property Q same-subject necessitates property P, with at least nomological necessity, and in addition (for *reductio*) that P bestows a new causal power C(K,E). For cases of same-sub-

ject necessitation, we can assume that Q is not part of the circumstances K, but can be instantiated in K.[6] Now, Q necessitates P in K, so Q is nomologically sufficient for P in K. And P in K is nomologically sufficient for E. By transitivity of nomological sufficiency, Q is nomologically sufficient for E in K, and (since K alone is not nomologically sufficient for E), then by *Causal Powers Bestowal (nomological sufficiency)*, Q bestows C(K,E). The general idea is this: suppose one of my brain properties necessitates one of my mental properties, and the mental property bestows some causal power on me. Since we're assuming that causal power bestowal is just a matter of nomological sufficiency, my brain property will, in virtue of necessitating the mental property, also bestow this causal power on me.

In the above argument, causal power C(K,E) was perfectly general. So in all cases where P is same-subject necessitated by Q, Q will bestow every causal power that P bestows. By the lights of *Causal Powers Over and Aboveness*, no same-subject necessitated property can be over and above its necessitating property; and (as a special case) no same-subject necessitated property can be over and above any physicalistically acceptable property that necessitates it. Thus physicalism turns out to be, for these cases, trivially true.

This result is surprising. Physicalists have expended a great deal of energy on establishing that *Condition on Causal Powers* is met in cases of same-subject necessitation. Why the bother, if it was this easy to establish that physicalistic acceptability is preserved in cases of same-subject necessitation?

Causal Powers Bestowal (nomological necessity)

The next thing I want to show is that, in cases of same-subject necessitation, when causal power bestowal is understood in terms of *Causal Powers Bestowal (nomological necessity)*, *Condition on Causal Powers* is trivially (in the sense of: immediately, given certain uncontroversial assumptions) violated.

6. For by *Causal Powers Bestowal (nomological sufficiency)*, K by itself is not nomologically sufficient for E. But if Q were part of K, then K would be nomologically sufficient for E (since Q in K is nomologically sufficient for P, and P in K is nomologically sufficient for E). And since Q and P are properties of a single subject, I'm going to assume that, where P is necessitated by Q, Q and P can be instantiated in the same circumstances.

Suppose that properties Q1 and Q2 each same-subject necessitate property P, with at least nomological necessity, and assume that P bestows causal power C(K,E). Again, we can assume that neither Q1 nor Q2 are part of the circumstances K, but that each can be instantiated in K. Now, consider a case where Q1 necessitates P. Since P is also necessitated by Q2, Q1 isn't *necessary* for E in K. And the same holds for Q2. So, by *Causal Powers Bestowal (nomological necessity),* neither Q1 nor Q2 bestows C(K,E). The general idea is this: suppose either of two of my brain properties is sufficient for one of my mental properties, and the mental property bestows some causal power on me. Since we're assuming that causal power bestowal is a matter of nomological necessity, as well as sufficiency, and since neither brain property is *necessary* for the effect in question, neither brain property will bestow this causal power on me.

This makes room, in cases of same-subject necessitation, for the bare possibility of *Condition on Causal Powers* being violated, and hence for the bare possibility of "over and aboveness" in these cases. But does this bare possibility make sense of the debate between physicalists and emergentists? No. It's a commonplace – in particular, physicalists and emergentists agree – that (at least some) mental properties are multiply same-subject necessitated by physicalistically acceptable properties. All such mental properties will bestow causal powers that their necessitating physical properties don't bestow and so these mental properties (indeed, multiply same-subject necessitated properties, generally speaking) will be over and above their necessitating physicalistically acceptable properties. This result is also surprising. Was this all it took to falsify physicalism?

IV. *The Over and Above Boundary Problem*

These trivality results make no sense of the ongoing debate between physicalists and emergentists, nor of the fact that nearly all physicalist and emergentist accounts have presupposed that the holding or not holding of *Condition on Causal Powers*, as reflected in *Causal Powers Over and Aboveness*, sufficed to distinguish these accounts. I call this unhappy state of affairs "the over and above

boundary problem."[7] So, what's our next move?

One pessimistic move would be to pronounce the whole debate between physicalists and emergentists fundamentally confused; one deflationary move would be to commit to one or other of the accounts of causal power bestowal above, and accept accordingly either the trivial truth or the trivial falsity of physicalism. What I'm going to do instead is optimistically assume that both physicalism and emergentism are substantive, contrasting doctrines, and search for a solution to the over and above boundary problem that makes sense of the debate. Toward this end, I take it that a working solution must meet three constraints and, if possible, satisfy one desideratum.

First, it must make sense of the physicalist and emergentist responses to the threats of overdetermination and epiphenomenalism, and of the many formulations of these doctrines, by having something recognizably like *Causal Powers Over and Aboveness* at its core. Second, a working solution must make room for the bare possibility of over and aboveness (hence of physicalistic unacceptability) in cases of same-subject necessitation:

> *Bare Possibility of Over and Aboveness*: A working conception of over and aboveness should not rule out the bare possibility of over and aboveness in cases of same-subject necessitation.

(This constraint acts to prevent physicalism's being trivially true.)

7. Note that there is another boundary problem that physicalists and their rivals need to solve, if their accounts are to be satisfactorily formulated; namely, the physical/non-physical boundary problem. Unlike the over and above boundary problem, physicalists and their rivals generally acknowledge the lack of any satisfactory analysis of what it is for a property to be physical, as opposed to non-physical. However, they assume that it is sufficient, for purposes of debate, to intuitively characterize the set of physicalistically acceptable properties. The real wrangling then proceeds by reference to the question of whether any properties exist that are over and above the properties in the intuitively characterized set. I will not attempt to solve the physical/non-physical boundary problem here; the point of the remainder of this paper is to consider whether, modulo solving this problem, we can make sense (in a way that is sensitive to existing formulations of physicalism and emergentism) of what it is for a same-subject necessitated property to be over and above whatever properties in the base set necessitate it.

Third, a working solution must make room for this possibility in such a way that it is not trivially true, in a broad sense that it is not immediate (as it was in the cases involving multiple necessitation that we considered) that there are over and above properties:

> *Non-Triviality of Over and Aboveness*: A working conception of over and aboveness should not trivially entail that there is over and aboveness in cases of same-subject necessitation.

(This constraint acts to prevent emergentism's being trivially true.) Finally, I will consider it a desideratum of a working solution that it not result in immediate stalemate between physicalists and emergentists: other things being equal, a solution to the over and above boundary problem that shows what an *illuminating* end to the physicalism/emergentism debate would look like is to be preferred.

Now, there are a variety of possible revisions of either *Causal Powers Over and Aboveness* or *Causal Powers Bestowal* that could be considered here. (I consider these possible revisions in detail in my dissertation, *Physicalism, Emergentism and Fundamental Forces*.) In the interest of efficiency, I'm going to cut to the chase and consider what seems to me the best shot at solving the over and above boundary problem, among revisions appealing to the usual metaphysical suspects. I'll show why this suggestion is unsatisfactory, and then go on to present my own solution to the problem.

V. *Revising Causal Powers Bestowal*

The best-shot suggestion proceeds by revising *Causal Powers Bestowal*. What seems to be lacking, in *Causal Powers Bestowal*, is any means of judiciously associating causal powers with properties. But one might think that there is natural way to fill this lack, namely, by attention to the causal laws, a.k.a. "laws of nature," that subsume the causal interactions at a world. In other words, we might try to distinguish what causal powers are bestowed by a property by reference to what causal laws the property enters into. This approach has some precedent in emergentist and physicalist

accounts. Broad, for example, took a property's being over and above any physical property to be a matter of its being governed by laws that were *trans-physical* – that is, laws that were not deducible, even in principle, from laws governing physical entities and properties.

As it happens, Broad's "in-principle failure of deducibility" account of emergence does not suffice as a criterion to distinguish between laws, or systems of laws, since many uncontroversially physical properties – for example, chaotic properties of the atmosphere – are governed by laws that are not deducible, even in principle, from laws governing their necessitating physical properties. (See David Newman 1996 and Mark Bedau 1997 for discussions of this point.) We might hope, however, that one or other of the accounts of laws of nature on offer could distinguish between laws, in such a way as to allow for a finer-grained understanding of causal power bestowal.

There are two main accounts of such laws, which divide roughly along regularity and realist lines. According to standard regularity accounts, laws are merely a matter of property correlations, as holding over some appropriately wide region of space, time, or worlds. Now, we already have reason to believe that grounding *Causal Powers Bestowal* in a regularity account of laws won't judiciously associate causal powers with properties. For the previous trivializations of physicalism and emergentism came from combining *Causal Powers Over and Aboveness* with accounts of *Causal Powers Bestowal* that were understood merely in terms of actual and counterfactual property correlations, involving either nomological sufficiency or nomological necessity.

Moreover, there are good inductive grounds for thinking that no account of laws, on which these are just a matter of property correlations, can judiciously distinguish cases which do involve over and aboveness from cases which don't. As previously mentioned, it seems likely that for any property correlation that may be suggested, emergentists and physicalists may each provide stories of how their preferred relation satisfies those correlations. If property correlations can't track over and aboveness in cases of supervenience, it's difficult to see how they could do so here. Undergirding *Causal Powers Bestowal* with a property correlation account of laws thus seems doomed to violate either the *Bare Possibility* or *Non-Trivial-*

ity constraints on over and aboveness.[8]

Can we can do better by understanding *Causal Powers Bestowal* in terms of one or other realist accounts of laws, according to which these are something besides mere regularities? Consider the most popular realist account of laws, often called the DTA account, after Fred Dretske, Michael Tooley, and David Armstrong, according to which laws are second-order relations between properties. (These properties and relations are usually understood as universals, but evidently they need not be so understood.) On this construal, causal interactions are grounded in a particular relation of causal necessitation; call it N, and the holding of these N-relations is a matter of brute fact, unanalyzable in terms of regularities. So maybe we could have property P N-related to E, property Q same-subject necessitating P, but fail to have Q N-related to E. Then P's bestowing causal power C(K,E) would be primitive; and likewise Q's failing to bestow C(K,E). But there are two problems with this approach. First, a conception of over and aboveness based on this "primitivist" understanding of causal power bestowal is going to lead directly to stalemate between emergentists and physicalists. That's unsatisfactory, in its own right.

But there's a second, deeper, problem here. The alleged relation N is supposed to be a relation of nomological necessitation, where the "nomological" here is understood as involving brute robust connections, as opposed to just regularities. And however we understand "nomological," nomological necessitation is supposed to be a *transitive* relation; hence N should also be transitive. But now note that the relation between Q and P is supposed to be either some variety of nomological necessitation, or some variety of metaphysical

8. These remarks hold also, I believe, for more sophisticated regularity accounts of laws, on which (as on David Lewis's "Best System" account) what regularities are to count as laws is constrained by considerations such as simplicity and strength. In fact, Lewis does not rely on his account of laws to distinguish emergent from non-emergent properties, but instead takes emergent properties to be distinguished from physicalistically acceptable properties in virtue of their being "alien" – roughly, not instantiated in the actual world. (See the introduction to Lewis 1986.) But of course, emergentists don't think that emergent properties are alien, so understanding "over and aboveness" in terms of alien-hood leads directly to stalemate between physicalists and emergentists.

necessitation. If it's nomological necessitation, then supposedly it is going to be of the robust variety favored by proponents of the realist accounts we are now considering. So Q will be N-related to E. And P is N-related to E; so by transitivity of N, Q has to be N-related to E. It looks like this result will also attach to cases where Q is supposed to be related to P with metaphysical necessity: consider the limiting case where Q is identical with P, in which case Q will be N-related to E, if P is. It seems unlikely that N-relations can hold in the ways needed in order to avoid violating the *Bare Possibility* constraint.

Another realist account of laws (sometimes termed "dispositional essentialism") takes what laws there are to be written into the causal dispositions – causal powers, by any other name – of properties at a world. Now, what determines what causal dispositions a given property has? Again, on the usual accounts this is a matter of brute fact. So we might try to suppose that P is causally disposed to produce E, Q necessitates P, but Q is not causally disposed to produce E. But such a supposition again violates the transitivity of nomological necessity. Even putting aside this objection, dispositional essentialism, even more clearly than the previous approach, leads directly to stalemate: Emergentists will claim that some same-subject necessitated properties are essentially causally disposed in ways that their necessitating physical properties are not, and physicalists will deny this. In other words: emergentists will claim that, as a matter of brute fact, some same-subject necessitated properties bestow causal powers that their necessitating physicalistically acceptable properties do not bestow, and physicalists will deny this. That's about as unilluminating as it gets.

VI. *A Force-Relative Version of* Causal Powers Over and Aboveness

I'm now going to put my own solution to the over and above boundary problem, which proceeds by keeping the commonly endorsed Causal Powers Bestowal (nomological sufficiency) as it stands, and revising *Causal Powers Over and Aboveness*, on the table. At this point the suggestion is programmatic. My main purpose in the remainder of this paper is to convince you that the notion of a *funda-*

mental force, upon which the suggestion is based, is worthy of further detailed investigation.

We can start by noting that a conception of over and aboveness based on the action of fundamental forces has precedent in the literature. Brian McLaughlin, summarizing trends in British Emergentism, says the following:

> Consider the doctrine that there are fundamental powers to influence motion associated with types of structures of particles … In a framework of forces, the view implies that there are what we may call "configurational forces": fundamental forces that can be exerted only by certain types of configurations of particles … (1992, 52)

Horgan concurs:

> The British Emergentists … maintained that at various junctures in the course of evolution, complex physical entities came into being that had certain non-physical, "emergent" properties. These properties, they claimed, are fundamental force-generating properties, over and above the force-generating properties of physics; when such a property is instantiated by an individual, the total causal forces operative within the individual are a combination of physical and non-physical forces. (1993, 557)

McLaughlin notes that most of the British Emergentists were reluctant to reify forces, and goes on to claim "We could, if we like [for purposes of laying out the Emergentist position], recast talk of forces in terms of talk of the properties that influence motion." (1992, 65) One of the points of the present discussion is that such a recasting of force-talk will not make sense of the possibility of over and aboveness (at least it won't, if the properties at issue are properties of the subjects in cases of same-subject necessitation). For talk of properties and what motions they influence is likely to come down to talk of properties and what causal powers they bestow. But if my previous arguments are correct, there is no good way to separate, at least by appeal to the usual accounts of causal powers and laws, the "influencing of motion" due to a same- subject necessitated property, from the "influencing of motion" due to its necessitating property. This means that a framework including (something very like) fundamental forces may not be optional, when it comes to formulating over and aboveness for cases of same-subject necessitation.

So, what can fundamental forces – paradigmatically, the gravitational, electromagnetic, and strong and weak nuclear forces – do, that the usual accounts of causal powers and laws can't? Let's start by recalling that, in investigating the notion of law, we were looking for a way of grounding causal power bestowal in more than mere regularities; and the best that we could do, on the usual accounts, was to ground these in brute fact. But now observe the following truisms. The causal power of being able to bond with an electron, in circumstances where the electron is free and sufficiently proximate, bestowed upon a proton by the property *being positively charged*, is grounded in the electromagnetic (or if you like, the electroweak) force, as opposed to the strong nuclear force or gravitational force. The causal power of being able to bond with other atomic nuclei in a stable configuration is grounded in the strong nuclear force, as opposed to the electromagnetic, weak, or gravitational forces. The causal power of being able to fall when dropped, in circumstances where one is poised above Earth's surface, bestowed by the property *having mass M*, is grounded in the gravitational force, as opposed to the other fundamental forces in operation. The causal power of being able to sit on a chair without falling through it, in circumstances where one is a human attending a Terry Horgan symposium, is grounded (at least) in the gravitational and the electromagnetic forces. And so on, and so on. In virtue of grounding the causal powers bestowed by properties, fundamental forces explain, organize and unify vast ranges of natural phenomena.

What does it mean to say that the causal powers of properties are grounded in fundamental forces? Details of this grounding relation, as well as details of what ontological category fundamental forces fall into, will have to wait for the outcome of my investigations, or the investigations of others. (I provide a preliminary account of the grounding relation in my dissertation chapter, "Force-relative Over and Aboveness".) But, as the above truisms indicate, that there *is* such a grounding relation seems compellingly and intuitively correct. So let's assume, vaguely for now, that causal powers are "grounded in" certain forces. And let's fix a set of fundamental forces F. We can then consider the causal powers which are bestowed by a property *relative* to this set, as being those causal powers bestowed by the property which are grounded *solely in the forces*

in F. For cases of same-subject necessitation, this approach gives rise to the following conception of over and aboveness:

> *Force-relative Over and Aboveness*: Given a set of fundamental forces *F*: Where property P is same-subject necessitated by property Q, P is over and above Q, relative to *F*, just in case P bestows a causal power different from any of those causal powers of Q *that are grounded only in forces in F*.

Force-relative Over and Aboveness preserves the intuition, expressed in *Causal Powers Over and Aboveness*, that an over and above same-subject necessitated property P has one or more causal powers that are "new" relative to its necessitating property Q. It just makes explicit what the relevant sense of "new" is – namely, new relative to those causal powers of Q *that are grounded in some particular set of forces F*. Restricting our view via a form of "selective attention" to just those causal powers of Q that are grounded in the fundamental forces in *F* gives us a principled means of distinguishing the causal powers relative to which P is supposed over and above Q, from other causal powers bestowed by Q. This makes room for the possibility of P's being over and above Q; hence *Force-Relative Causal Powers Over and Aboveness* satisfies the *Bare Possibility* constraint.

Force-Relative Causal Powers Over and Aboveness also satisfies the *Non-Triviality* constraint, by judiciously distinguishing between cases of same-subject necessitation where over and aboveness is at issue, and cases where it isn't. Recall that a previous violation of this constraint involved properties being deemed over and above their necessitating properties, simply in virtue of being multiply necessitated. *Force-Relative Causal Powers Over and Aboveness* avoids violating the *Non-Triviality* constraint this way. Let *F* consist of some set of fundamental forces. Then a property P same-subject necessitated by Q1, Q2, etc., will not be over and above Q1, Q2, etc., relative to *F*, *unless* P bestows a causal power different from any causal power bestowed by Q1, Q2, etc., that is grounded only in forces in *F*.

Given a force-relative conception of over and aboveness, we can formulate substantive, contrasting accounts of physicalism and emergentism for cases of same-subject necessitation. Or rather, we

can formulate these accounts *if* we can make sense of the distinction between physical and non-physical fundamental forces. Here's a first-pass attempt at doing so: Let F be the set of fundamental forces that come into play at or below the atomic level of organization, and let's grant, as seems plausible, that any such force is appropriately deemed "physical."[9] Then the following thesis will be common to all varieties of physicalism:

> *Physicalism (same-subject necessitation)*: For every property P and Q: If Q same-subject necessitates P, **every** causal power bestowed by P is identical with a causal power bestowed by Q *that is grounded only in the fundamental forces in F*.

Emergentists, in contrast, will maintain that some same-subject necessitated properties P *are* over and above their necessitating properties, relative to the fundamental forces in *F*.

> *Emergentism (same-subject necessitation)*: For some properties P and Q: Q same-subject necessitates P, and **at least one** causal power bestowed by P is **not** identical with **any** causal power bestowed by Q *that is grounded only in the fundamental physical forces in F*.

Emergentism so characterized is committed to there being at least one other fundamental force beyond those fundamental forces currently posited, that comes into play only at certain relatively high levels of organization – perhaps, for example, those levels involving complex neurological systems. Whether or not there is such a fundamental force can then be a matter for further philosophical and scientific investigation. This means that physicalists and emergentists avoid immediate stalemate. As a side-benefit, *Force-relative Causal*

9. In fact, this criterion seems sufficient but not necessary for a fundamental force's being physical. But as previously mentioned, my goal here is not to solve the physical/non-physical boundary problem, as this problem attaches, in particular, to fundamental forces, but rather to show how fundamental forces allow for a solution to the over and above boundary problem that (modulo solving the physical/non-physical boundary problem) allows physicalism and emergentism to be formulated as substantive, contrasting doctrines.

Powers Over and Aboveness can capture, as *Causal Powers Over and Aboveness* could not, the elusive superdupervenience.

VII. *Revisiting Horgan's Constraint*

But now an interesting question arises, which brings us back to *Horgan's Constraint*. Supposing an appeal to fundamental forces is needed in order to make sense of superdupervenience, does such an appeal amount to a tacit reintroduction of *Horgan's Constraint*? The answer, as I see it, is both "No" and "Yes."

The answer is "No," if (as Horgan's discussion implied) the robust ontological explanation at issue requires our explaining, in the sense of making intelligible, via conceptual entailment, definition, or what-have-you, the characteristic features of a supervenient property in terms of the characteristic features of its base property. It's true that my account of superdupervenience requires that a robust ontological connection hold between the properties involved: namely, every causal power bestowed by the supervenient property must be identical with a causal power bestowed by its base property, that is grounded only in fundamental physical forces. But establishing this connection does not require that any explanatory relation of intelligibility hold between characteristic features of the properties. On the contrary, we can establish the requisite causal power identities merely by establishing that no new fundamental forces are in operation in either the instantiation of or causal transactions involving the necessitated property. And in investigating whether any new fundamental forces are in operation, we can help ourselves to whatever ways and means that scientists do.

One such way makes use of the conservation laws of mass-energy and momentum. Suppose a theory presupposes a set of fundamental forces F, and suppose that, according to this theory, a bunch of particles has a certain amount of momentum. We throw the particles together in a super-collider, and find out that the particles resulting from this interaction have less momentum than those going in. Rather than give up the associated conservation law, the preferred option is to take such apparent failures of conservation as indicating the presence of another force, carrying away the missing momen-

tum. It was considerations similar to these, having to do with apparent failures of conservation of mass-energy, that led to the discovery of the weak nuclear force.

We could use a similar approach to show that a given property P, same-subject necessitated by a micro-structural property Q, was over and above Q. Suppose our theory presupposes a set of fundamental forces *F*, and suppose that, according to this theory, a bunch of particles in a particular structural configuration, constructed using just forces in *F*, will have a certain energy. We construct such a micro-structural entity, which thereby instantiates a micro-structural property Q. Suppose that we have reason to think that Q same-subject necessitates some other property P. Is P over and above Q? Well, measure the energy associated with the complex configuration, or associated with causal interactions involving P, and see. If there's less energy coming out than going in, we might well be inclined to conclude, following accepted scientific procedure and as per the emergentist thesis, that a new "configurational force" was in operation.

Assuming we can make sense of these sorts of methodological indications, we need not wait on explanations of the characteristic features of one same-subject necessitated property in terms of the characteristic features of another, in order to conclude that the former is nothing over and above the latter. In the example just given, for example, we had only to establish that the energy associated with the necessitated property was neither more nor less than the energy associated, via a theory presupposing only a prescribed set of fundamental forces *F*, with the necessitating property. More generally, we can establish nothing over and aboveness, and in particular, superdupervenience, by establishing that the instantiation of, and causal transactions involving, a same-subject necessitated (supervenient) property, do not give rise to any anomalies that would indicate the presence of a fundamental force different from those in the prescribed set *F*. Under these circumstances, it will be reasonable to conclude that every causal power bestowed by the necessitated property is identical with a causal power bestowed by the necessitating property that is grounded only in the forces in *F*.

On the other hand, if the notion of robust explanation at issue in *Horgan's Constraint* can be extended to include establishing the sort

of ontologically robust connection at issue in *Force-relative Over and Aboveness*, then I am happy to allow that superduper- venience requires *Horgan's Constraint*. In any case, I'm agreeing with the main point of Horgan's illuminating paper; namely, that a physicalistically acceptable supervenience must be grounded in robust ontological connection, going beyond mere property correlations.

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