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MUST STRONG EMERGENCE COLLAPSE?

Umut Baysan and Jessica Wilson

ABSTRACT

There have recently been complaints from various quarters that strong emergence doesn't make sense, on grounds that any purportedly strongly emergent features or associated powers can be seen to 'collapse', one way or another, into the lower-level base features upon which they depend. On one version of this collapse objection, certain ways of individuating lower-level physical features entail that such features will have dispositions to produce any purportedly strongly emergent features, undermining the supposed metaphysical novelty of the emergent features and the physical acceptability of the base features (see Howell 2009 and Taylor 2015). On another, certain ways of assigning powers to features entail that lower-level physical features will inherit any powers had by purportedly strongly emergent features (see Kim, 1998 and 2006, and others). Here we present and defend four different responses that might be given to the collapse objection as directed against a 'novel power' approach to strong emergence: first, distinguishing between direct and indirect having of powers; second, distinguishing between lightweight and heavyweight dispositions; third, taking strong emergence to be relative to sets of fundamental interactions; fourth, taking strongly emergent features to be 'new object entailing', in ways that block lower-level inheritance of powers.

1. Introduction

The notion of metaphysical emergence is inspired by cases in which some seemingly higher-level goings-on broadly synchronically depend on some (typically highly complex) lower-level physical goings-on, and yet the dependent goings-on appear to be both distinct from, and distinctively efficacious as compared to, these lower-level goings-on.[1] Such cases are rife throughout the special sciences, and include cases in which gasses, while dependent on features of the systems of atoms or molecules composing them, exhibit so-called "universal" behaviours near critical points, cases in which certain global properties of honeybee hives depend on but appear to transcend the aggregative behaviours of individual bees, and cases in which qualitative mental states depend on complex neurological (and ultimately highly complex lower-level

[1] By "broadly synchronic" we have in mind that an emergent feature and its dependence base may jointly extend over a temporal interval; emergence need not be instantaneous. The intended contrast here is in the first instance with diachronic relations such as causation, where one of the relata is understood to occur or be instantiated temporally prior to the other. It is worth noting here that not all diachronic accounts of strong emergence are opposed to a broadly synchronic conception, insofar as causal conceptions *à la* O'Connor (2000) can arguably be reconceived in terms of synchronically had powers; similarly for Mill's account of strong emergence as involving heteropathic effects (see Wilson 2015 and forthcoming for discussion). Some diachronic accounts of emergence, for example Humphreys' (1997) account of emergent "fusion", are irreducibly diachronic, but insofar as this type of emergence does not involve an underlying dependence base of the sort at issue in the target cases, it concerns a different phenomenon.

physical) states to which qualitativity is not clearly appropriately ascribed.

Accounts of metaphysical (as opposed to merely epistemic or representational) emergence, which take the appearances of autonomy to be genuine, are typically characterized as either "weak" or "strong", reflecting whether or not the emergence at issue is supposed to be compatible with physicalism, the view that all broadly scientific goings-on are "nothing over and above" physical goings-on.[2,3] Though weak and strong varieties of emergence differ in respect of compatibility with physicalism, they typically have in common a commitment to "substance monism", and more specifically, a commitment to there being only physical substance, by way of contrast with views such as Cartesian substance dualism or vitalism. Given the commitment to substance monism, accounts of emergence for the target cases involving broadly

[2] The "broadly scientific" goings-on are those that are part of natural (including social) reality. The schematic expression "nothing over and above" is, somewhat misleadingly, intended to be compatible with non-reductive as well as reductive versions of physicalism.

[3] "Weak" emergence is also sometimes characterized as an epistemic phenomenon (see, e.g., Chalmers 2006), involving goings-on which, while ontologically and causally reducible to lower-level physical goings-on, are unpredictable, surprising, or such as not to admit of explanation in lower-level terms. Both epistemic and metaphysical conceptions of weak emergence are supposed to be compatible with physicalism, given the physical acceptability of the base entities. There is a large literature over whether weak metaphysical emergence makes sense, notably associated with Kim's causal exclusion argument against non-reductive physicalism. We believe that weak metaphysical emergence does make sense, but in any case our primary interest here is with strong emergence, understood as the sort of emergence which is both properly metaphysical and such that its occurrence would falsify physicalism.

scientific goings-on have focused on what it would be for there to be dependent, distinct, and distinctively efficacious higher-level *features* of either physically acceptable (weak) or physically unacceptable (strong) varieties. It is also worth noting—a point to which we will later return—that the commitment to substance monism is often seen as compatible with emergent and base features' being had by different objects.

Our focus in what follows will be on whether strong emergence makes sense, in light of a certain form of objection. Most examples of seeming emergence (e.g., involving non-linear thermodynamic phenomena) are reasonably thought to be compatible with physicalism, and so at best to be cases of weak emergence. In that case, why care about whether strong emergence makes sense? One reason is that there remain phenomena which appear to broadly synchronically depend on lower-level physical goings-on, but for which it remains unclear how these phenomena could be fully constituted by lower-level goings-on, no matter how complex. Perhaps the most cited case of this sort, associated with what Chalmers (1995) calls "the hard problem", is that of a phenomenal or qualitative mental state: a state that a conscious being can have or be in insofar as there is "something it is like" to be in that state (Nagel 1974). There is certainly something to Chalmers's (1996) observation, echoing Broad's (1925) view, that there is little hope that phenomenal consciousness will ever be explained along lines of the sort of model whereby, e.g., the features of water—liquidity, ability to flow—came to be seen as "nothing over and above" features of hydrogen and oxygen atoms, when properly combined and aggregated. Coupled with a healthy dislike of panpsychism, one might be inclined to infer from such an explanatory failure to the strong emergence of conscious mental states, as does van Cleve (1990); see also Noordhof (2003, 2010). More generally, the idea that phenomenal consciousness cannot be fully explained in terms of physical goings-on, even in principle, has been often taken to support an anti-physicalist—that is, strong—version of emergentism (Broad 1925, Chalmers 2006).

Another case, less discussed but perhaps more important in the human scheme of things, concerns free will, understood as involving free choosing: the ability to mentally choose an outcome, where the outcome is "free" in being, in some substantive sense, up to the agent of the choice. To be sure, there are compatibilist accounts of free choice, which some see as accommodating the distinctive efficacy of such choice, via a strategy that is relevantly similar to that which weak emergentists implement in order to accommodate mental causation (see Bernstein and Wilson 2016 for discussion). Still, many are inclined to think that any account of choice which is compatible with determinism is not one on which free will is *really* free, in a sense supporting non-revisionary accommodation of the role free choice plays in our moral and cognitive economy. The alternative, libertarian, conception of free will provides the basis for a more robust conception of choice, again naturally understood in terms of strong emergence, whereby genuinely free agents are taken to have fundamentally new powers—powers that depend on yet somehow transcend the nomological net of lower-level physical goings-on. Lowe (2013), for example, argues that the exercise of human will involves a distinctive power,[4] and more generally takes minds or persons to be strongly emergent partially in virtue of having powers not identical to any lower-level physical powers, including powers of complex lower-level aggregates (see also Lowe 2006 and Merricks 2003).

Now, in spite of there being intuitively live candidates for strongly emergent features when such emergence is pitched in abstract terms, there is an oft-repeated concern that closer attention to the notions of dependence or autonomy at issue in specific accounts of strong

[4] Lowe (2013) calls the power associated with free choice "non-causal", since unlike the typical powers of physical features, it can be exercised without being triggered. Granting this distinction, it is in any case irrelevant to the issues under discussion here.

emergence reveals that the notion of a strongly emergent feature makes no sense. The problem is associated with what Taylor (2015) evocatively calls the "collapse" objection, versions of which have been raised by a number of philosophers, including Pepper (1926), van Cleve (1990), Kim (1998) and (2006), Shoemaker (2007), Howell (2009), and Taylor (2015). The general concern is that any purportedly strongly emergent features or associated powers can be seen to "collapse", one way or another, into the lower-level base features upon which they depend, which undermines the supposed metaphysical and causal novelty or associated non-deducibility of the strongly emergent features vis-à-vis base features (Kim, van Cleve, Shoemaker, Taylor), and moreover, if the supposed physical unacceptability of strongly emergent features is held fixed, threatens the physical acceptability of the base features (Howell).

Here we assess four responses that might be given to the collapse objection(s), as directed against a "fundamentally novel power" account of strongly emergent features. We first motivate and present the powers-based account (Section 2); we then canvass the two main versions of the collapse objection, show how these apply to the powers-based account, and problematize certain strategies of response (Section 3). We then present and defend four better strategies of response, appealing to a distinction between *direct and indirect having of powers*, a distinction between *lightweight and heavyweight dispositions*, a view on which strong emergence is relativized to sets of *fundamental interactions*, and a view on which strongly emergent features or powers must be had by *new objects* (Section 4). We conclude that there are several independently motivated and defensible means of preventing the collapse of strongly emergent features or powers into their lower-level bases.

2. The powers-based approach to strong emergence

There are a number of different accounts of strong emergence on offer (see Wilson 2015 for an overview), including those on which strongly emergent features are not deducible, even in principle, from lower-level physical goings-on (as per Broad's 1925 formulation, about which more anon), those on which such features supervene with nomological but not metaphysical necessity on lower-level physical goings-on (Chalmers 2006, van Cleve 1990, Noordhof 2003, 2010), and those on which such features have (or bestow; here we stick with variants of "having") fundamentally novel powers—powers not had by lower-level physical goings-on (the British Emergentists, McLaughlin 1992, O'Connor 1994, Silberstein and McGeever 1999, Kim 1999, Wilson 1999 and 2015, Crane 2001, van Gulick 2001, O'Connor & Wong 2005, Silberstein 2006).[5] Here we focus on the collapse objection as it applies to a powers-based account of strong emergence, both to fix ideas and because such an account is operative not just in most metaphysical accounts of such emergence but also in most epistemic or modal accounts, which also typically target a conception of strong metaphysical emergence.

To start, notwithstanding Broad's (1925) formulation of emergence in terms of "in-principle failure of deducibility", he clearly took physically

[5] Recall that the base-level features at issue are features of typically highly complex lower-level relational aggregates or pluralities; hence the novel powers at issue in strong emergence are fundamentally rather than non-fundamentally novel, where non-fundamental novelty reflects merely that some lower-level goings-on come to be spatiotemporally or otherwise related or aggregated, as when, e.g., the mass of a composed entity has powers none of its individual composing parts have.

unacceptable emergence to be a metaphysical phenomenon, involving fundamental novelty of higher-level laws and powers:

> [T]he law connecting the properties of silver-chloride with those of silver and of chlorine and with the structure of the compound is, so far as we know, a unique and ultimate law. (64-5)

See also Broad's observation that should there be any strong emergence, "we have to reconcile ourselves to much less unity in the external world and a much less intimate connection between the various sciences" (77). Broad's failure-of-deducibility account reflected his assumption (later discredited by the advent of chaotic non-linear phenomena, as well as certain mathematical limitations of the sort discussed in Boyd 1980; see Wilson 2013b for discussion) that failures of deducibility were sufficient indicators of such fundamental novelty. More generally, as McLaughlin (1992) correctly observes:

> Emergentists often speak of emergent properties and laws as unpredictable from what they emerge from. But, contra what some commentators have thought, the Emergentists do not maintain that something is an emergent because it is unpredictable. Rather, they maintain that something can be unpredictable because it is an emergent. Emergence implies a kind of unpredictability. But it is a mistake to conflate emergence with this consequence of emergence. The British Emergentists do not. (55, fn 31)

Thus, and more specifically, McLaughlin characterizes British Emergentism in powers-based terms, as "the doctrine that there are fundamental powers to influence motion associated with types of structures of particles that compose certain chemical, biological, and psychological kinds" (1992: 52).

Similarly, accounts of strong emergence as involving failures of metaphysical necessitation or supervenience reflect the supposition that

strongly emergent features have powers associated with fundamentally novel laws of nature, such that in worlds with only physical goings-on or laws, such features would be absent. To be sure, supervenience-based accounts are subject to counterexamples, wherein weakly emergent features supervene with only nomological necessity on base features (see Wilson 2015), and strongly emergent features supervene with metaphysical necessity on base features (see, e.g., Horgan 1993 and Wilson 2005); but even if further commitments entail a distinction in strength of correlation here, this distinction would be, as with any supposed distinction in deducibility or predictability, a consequence of rather than constitutive of the emergence at issue. Rather than try to reconceive the dependent novelty at the heart of strong emergence in flawed epistemic or modal terms, better to characterize such emergence in terms properly illuminating what is metaphysically at issue.

Indeed, most contemporary accounts of strong emergence are explicit that strong emergence involves fundamental novelty of the sort bringing new powers in its wake. Hence Silberstein and McGeever (1999) characterize strong emergence as follows:

> Ontologically emergent features are neither reducible to nor determined by more basic features. Ontologically emergent features are features of systems or wholes that possess causal capacities not reducible to any of the intrinsic causal capacities of the parts nor to any of the (reducible) relations between the parts. (186)

Silberstein (2006) is explicit in taking this form of emergence to "cast doubt on physicalism" (203-4). O'Connor and Wong (2005) similarly characterize strongly emergent features as conferring fundamentally novel powers:

> [A]s a fundamentally new kind of feature, [an emergent feature] will confer causal capacities on the object that go beyond the

> summation of capacities directly conferred by the object's microstructure (665).

Wilson (1999) argues that a powers-based conception is motivated by attention to the contrasting physicalist and strong emergentist responses to the problem of mental causation:

> [T]hat a real empirical property has powers [is] common ground in ontological debates over properties. Given this weak constraint, [strong] emergentists and physicalists who allow that higher-order properties are real are committed to these properties having powers. Now, this commitment leads to the [problem of mental causation]: given that mental properties have powers to cause various physical effects, and given that the physical is causally closed (so that every physical effect [has] a purely physical cause) mental causes of physical effects are systematically overdetermined. The [strong] emergentist response [...] is to deny that the physical is causally closed, and to assert that mental properties are new additions to the world, with independent powers of their own. Physicalists committed to the causal closure of the physical and to the denial of systematic causal overdetermination [must rather] hold that every individual power of a given mental property is identical to a power of some physical property in its subvenient base. It is in this sense that physicalists hold that mental properties are "nothing over and above" their subvenient bases. (41)

Van Gulick (2002) registers a similar thought in his discussion of "radical" emergence:

> If wholes or systems could have powers that were radically emergent from the powers of their parts in the sense that those system-level powers were not determined by the laws governing the powers of their parts, then that would seem to imply the existence of powers that could override or violate the laws

> governing the powers of the parts [...] It is in this respect that radically emergent powers would pose such a direct challenge to physicalism, since they would threaten the view of the physical world as a closed causal system. (18-19)

Correspondingly, as Wilson argues (most recently, in her 2015), attention to powers provides a systematic, historically supported, and properly metaphysical basis for accommodating weak as well as strong metaphysical emergence, as per the following schemas:

Weak Emergence (WE): Token apparently higher-level feature *S* is weakly metaphysically emergent from token lower-level feature *P* on a given occasion just in case, on that occasion, (i) *S* broadly synchronically depends on *P*, and (ii) *S* has a (non-empty) proper subset of the token powers had by *P*.

Strong Emergence (SE): Token apparently higher-level feature *S* is strongly emergent from token lower-level feature *P* on a given occasion just in case, on that occasion, (i) *S* broadly synchronically depends on *P*, and (ii) *S* has at least one token power not identical with any token power of *P*.[6]

Wilson also argues that when the lower-level features are physical, implementations of the schemas will conform or not conform to physicalism, respectively. We do not rehearse her arguments here, since it is reasonable to assume, again following the majority of accounts of strong emergence, that a higher-level feature having fundamentally

[6] For a feature's being strongly emergent it plausibly suffices that the conditions are satisfied on at least one occasion by at least one instance of the feature in worlds with laws relevantly similar to the actual laws; for continuity with the schema for *WE*, we stick with the schema expressed in terms of occasions.

novel powers would be "over and above" the base feature in a way incompatible with physicalism.[7]

In what follows, then, we assume an account of strong emergence along lines of *SE*.[8] It is an open question whether there is actually any strong emergence of this variety, but we will not address this question here; our aim is rather to determine whether the collapse objection poses an in-principle barrier to the viability of *SE*. We will argue that it does not.

2.1 Some remarks about powers

Before continuing, it's worth saying a bit more about how we are understanding powers, and what it is for a feature to have a power, in what follows.

To start, we intend to be as neutral about the metaphysics of powers and their relation to features as possible. Talk of powers is here most basically understood as tracking what contributions the having of a given

[7] Yates (2016), argues that some dependent features having powers not had by their dependence base goings-on are strongly emergent (by lights of Wilson's account, in particular) but nonetheless compatible with physicalism; he offers certain geometrical properties of molecules by way of example. In our view, it is unclear whether the powers of geometrical properties are fundamentally novel, but in any case, at least some versions of the collapse objection also apply to understandings of strong emergence as compatible with physicalism.

[8] While a powers-based view is consonant with most accounts of strong emergence, it does not accommodate a view on which higher-level features might be both strongly emergent and epiphenomenal (as per, e.g., Chalmers' 1996 view of phenomenal/qualitative features). We put aside such accounts here, since it is traditionally constitutive of the notion of emergence that emergent features—including phenomenal/qualitative features—are efficacious, and moreover distinctively so (as compared to base features).

feature may make to the production of a given effect when instantiated in certain circumstances. In this broad sense we agree with Shoemaker's claim 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). Importantly, however, we do not presuppose that the powers that features actually have are either essential to or exhaustive of such features, for the following reasons.

First, we do not presuppose that features have their powers essentially, since even if properties and powers are only contingently associated, in any case goings-on in worlds with different laws of nature are irrelevant to the status as emergent (or not) of the actual broadly scientific goings-on in this world, which status is the concern of physicalists and their rivals. Here it is worth registering that, notwithstanding that it is common to claim that the physical acceptability of higher-level features requires that they *metaphysically* supervene on, or are *metaphysically* necessitated by, lower-level physical features, the necessitating or supervenience base goings-on are, it is typically correctly qualified, such as to include all and only whatever physical laws there might be—in which case goings-on in worlds where the laws are different are again irrelevant to questions pertaining to whether physicalism and strong emergentism can be viably formulated, and if so, how.

Second and relatedly, we do not presuppose that features have their powers exhaustively, since even if properties have non-causal aspects (e.g., primitive identities, or "quiddities"), these are posited in order to be hooks, effectively, for different laws of nature, which different laws

again are irrelevant to questions pertaining to whether and how physicalism can be viability formulated.[9]

One last clarification is in order. As Shoemaker (2003) notes, we can distinguish two kinds of powers had or bestowed by a feature F—namely, powers simpliciter and conditional powers—by reference to two kinds of circumstances, corresponding roughly to what intrinsic and relational features, respectively, may be instantiated, along with *F*:

> 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. (430-431)

As a benign simplifying measure, we here gloss the distinction between powers simpliciter and conditional powers (referring to both as just "powers") by ignoring the distinction between these two sorts of circumstances. We also elide, for simplicity, talk of the bearers of features as causes or causal contributors, instead speaking of features or their instances as such (though we will return to the issue of bearers down the line).

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[9] See Wilson (2015 and forthcoming) for more detailed discussion and defense of the claim that implementing the powers-based schemas for weak and strong emergence does not require causal essentialist or law-necessitarian accounts of features or powers.

These qualifications in mind, we offer the following minimal schema for when a feature has a given power:

Power Possession (schematic): Feature *F* has power *C(K,E)* just in case an instance of *F*, in circumstances *K*, causes (or contributes to causing) an instance of *E*, and the holding of *K* alone does not cause (or contribute to causing) instances of *E*.

We also aim to be as neutral as possible about which account(s) of causation might be at issue; in particular, our preferred responses to the collapse objection will not hinge on endorsement of any particular such account(s).

3. The collapse objection

Here we present the two main versions of the collapse objection, show how each applies to a powers-based account, and argue that certain responses to each version of the objection are unsatisfactory.

3.1 Base-level power inheritance

The first route to the collapse objection is one according to which the nomological connection between base and dependent features entails that any purportedly new power of a strongly emergent feature *S* will be inherited by its base feature *P*. An initial expression of this concern underlies what Kim (1998) calls a "crucial" or "critical" question:

> If an emergent, [S], emerges from basal condition P, why can't P displace [S] as a cause of any putative effect of [S]? Why can't P do all of the work in explaining why any alleged effect of [S] occurred? (32)

(We replace Kim's references to emergent 'M' with 'S', for continuity with our notation.) Kim (2006) expands on this concern, as follows:

> [S], as an emergent, must itself have an emergence base property, say P. Now we face a critical question: if an emergent, [S], emerges from basal condition P, why cannot P displace [S] as a cause of any putative effect of [S]? Why cannot P do all the work in explaining why any alleged effect of [S] occurred? If causation is understood as nomological (law-based) sufficiency, P, as [S]'s emergence base, is nomologically sufficient for it, and [S], as P*'s cause, is nomologically sufficient for P*. It follows that P is nomologically sufficient for P* and hence qualifies as its cause. (558)

Given that a feature's powers are a matter of what effects the having of that feature can contribute to causing, when in certain circumstances, the threat to a powers-based account of strong emergence is clear. For as above the strong emergentist standardly supposes that the dependence of a strongly emergent feature *S* involves, at a minimum, the base feature's being nomologically sufficient for the strongly emergent feature; moreover, nomological sufficiency is transitive. Consider, then, any power of *S* to contribute to causing an effect *E* in circumstances *K*. If causation is a matter of (or otherwise involves) nomological sufficiency in appropriate circumstances, if *P* is nomologically sufficient for *S* in *K*, and if *S* is nomologically sufficient for *E* in *K*, then *P* will also be nomologically sufficient for *E* in *K*, and so also have the power to contribute to causing *E* in *K*, ruling *S*'s strong emergence out of court. In short, since *P* is (at least) nomologically sufficient for *S*, any purportedly novel powers of *S* will be inherited by, hence collapse into, those of *P*.

Insofar as the line of thought here depends on certain assumptions about causation, certain associated responses immediately suggest themselves, including rejecting a view on which nomological sufficiency in the circumstances is sufficient for causation, denying that causation is transitive, and/or maintaining that, unlike strong emergence, causation

must be diachronic. But such responses are unsatisfactory, in our view. As regards the first suggestion: we are inclined to think (following Hall 2004) that accommodation of many intuitive cases of causation requires a notion of causation as "production", understood as involving, at a minimum, nomological sufficiency in the circumstances; if such cases are to be accommodated, the proponent of the first response will need to say more about what must be added to nomological sufficiency in order for a causal relation to be in place. That's a vexed question, but in any case other accounts of causation seem likely to introduce similar or other difficulties. In particular, if causation is counterfactual dependence (which notion Hall takes to be required in order to accommodate other intuitive cases of causation), such that a power is associated with a feature only if the associated effect is counterfactually dependent on the feature, two difficulties ensue. If the counterfactual dependence concerns the token instances of *S*, *P*, and *E*, then it might be reasonably thought that if *S*'s power to cause *E* reflects that a token of *S* is necessary in the token circumstances for *E,* then the token of *P* upon which *S* depended in those token circumstances would, since presumably necessary in those token circumstances for *S*, also be necessary in those token circumstances for *E*. So collapse remains. If the necessity at issue in the counterfactual account rather attaches to the types of the features involved, then a different problem arises—namely, that any higher-level feature with multiple dependence bases will be deemed strongly emergent, including multiply realized features that are intuitively physically acceptable. It shouldn't be that easy to falsify physicalism! And while it would be less costly to deny that causation must be transitive or to require that it be diachronic, these responses strike us as both overly committing and *ad hoc*.

Most importantly, even if it is possible to block taking *P* to cause *S* in cases of strong emergence, there would remain a case to be made that *P* inherits any powers of a feature *S* that at least nomologically depends on it. Here O'Connor's (1994) presentation of the following "strong

objection" to a powers-based account strong emergence, which he credits to Carl Ginet (p.c.), is apropos:

> If an emergent property is a necessary consequence of certain base-level properties (as is implied by the supervenience condition), then its instantiation is one of the potentialities of that set of properties. But then are not the further potentialities of this emergent property also a subset of the total set of potentialities of the base properties, in virtue of the necessary connection between the base properties and it? These further potentialities are simply potentialities of the base properties at one remove. And now one is led to wonder why we might ever think to postulate an emergent property at all, since it provides no explanatory gain over an account which excises the mediating link by taking the "further" potentialities as directly tied to the base properties. This objection implies, in effect, that the features of supervenience and novel causal influence are incompatible. (98)

The deeper collapse objection raised here does not hinge on the supposition that strong emergence is a causal relation, but rather on the supposition that *P* synchronically necessitates *S*—whether causally or not, no matter. That much alone suggests that anything that *S* can do in circumstances *K* is also something that *P* can do in circumstances *K*, such that there is no way for *S* to have a novel power, and hence no way for it to be strongly emergent. And while Pepper's (1926) discussion of emergence is framed in terms of new 'variables' as opposed to new powers, it is clear that he has a version of this collapse objection in mind: "An emergent law must, therefore, involve the emergence of new variables. But these new variables either have some functional relationship with the rest of the lower level variables or they haven't. [...] If they have, they have to be included among the total set of variables described by the lower level functional relation; they have to drop down and take their place among the lower level variables as elements" (242-

243). More generally, then, there is a case to be made that that if some base feature *P* of an object synchronically necessitates (at least nomologically) a higher-level feature *S*, the powers/dispositions/potentialities of *S* must already be powers/dispositions/potentialities of *P*.[10]

[10] A cousin of this version of the collapse objection is what Yates (2016) calls "the grounding objection", where 'grounding' is understood as a primitive or generic dependence relation whose holding is supposed to be operative in 'in virtue of' claims, and which is typically presumed to be transitive. Here the objector assumes that the strong emergentist will maintain that when a property *S* is strongly emergent, then (a) instantiations of *S* occur in virtue of instantiations of some physical property *P*; (b) an entity instantiating *S* has some causal power in virtue of *S*; (c) the entity does not have that causal power in virtue of *P*; but, the objector maintains, this makes no sense, since given (a) and (b), the denial of (c) follows from the transitivity of grounding. Here we would be inclined to respond that a grounding-based conception of synchronic dependence is supposed to go beyond mere necessitation, and to moreover (on a natural reading of 'in virtue of' claims) to capture complete rather than partial dependence; but strongly emergent features are not instantiated—at least not completely—'in virtue of' physical base features (hence it is that they are, traditionally and on our understanding, physically unacceptable). Hence strong emergentists will deny (a), and the grounding objection cannot get off the ground. As previously noted, however, Yates thinks that strong emergence (including one framed in terms of powers) is (at least for some strongly emergent features) compatible with physicalism; hence his preferred response is to distinguish (following Wilson 2014) between a purported generic (big-'G') grounding relation and specific (small-'g') grounding relations, and to maintain that the structure of a strong emergentism of the sort endorsing (a)-(c) is one appealing to distinct small-`g' relations, rather than to a single transitive relation. This response bears a structural similarity to our first response below (section 4.1), which proceeds by distinguishing direct from indirect powers.

O'Connor offers a response to the deeper collapse concern, but it is unsatisfactory. He suggests that if *P* is taken to inherit *S*'s powers, then the lower-level physical laws would have a "very odd complexity, involving tacked-on disjuncts to cover the special cases" (1994: 98). O'Connor's suggestion rests on two suppositions: first, that collapse would entail that lower-level entities (e.g., atoms) would interact with each other in a comparatively uniform way until entering into a complex aggregate, at which point they would start doing "quirky" things; and second, that such discontinuous behaviours would be best explained by positing strongly emergent features, since the subsuming of quirky behaviours under lower-level laws would appear disjunctively gerrymandered or arbitrary. But as stated, this natural thought doesn't withstand scrutiny; for physicalists (reductive or non-reductive) are happy to allow that quirky behaviour can come about simply as a result of sufficiently complex lower-level interactions—that's what the science of complexity is all about. Hence while there are successful responses to this version of the collapse problem (as we explore in Section 4 below), this is not one of them.

3.2 Dispositional feature inheritance

A second version of the collapse objection is that for any purportedly strongly emergent feature that is instantiated in certain complex circumstances, there is a dispositional micro-feature of which the strongly emergent feature is the manifestation. An early statement of this version of the objection is found in van Cleve (1990), who after arguing that strong emergence represents the best option for making sense of dependent but irreducible higher-level mental features, says of Broad's "in-principle deducibility" account:

> There is one more point about Broad's account that needs to be discussed. It could be objected to what has so far been said that there is simply no room for the concept of an emergent property,

> since for any property P of any whole w, there will always be properties of the parts from which P may be deduced. For example, is it not true of sodium that it comes with chlorine to form a whole having such-and-such properties, including its odor and anything else one might have claimed to be emergent? And from such properties of the parts, may not all properties of the whole be deduced? The answer, of course, is yes; but it is also clear that if properties of this sort are admitted in the "supervenience base," the doctrine of anti-emergence (or mereological reducibility, as it might be called) becomes completely trivial. (223-4)

Taylor (2015) develops this line of thought, observing that Broad took sodium chloride to be strongly emergent (that is, to have fundamentally novel powers, etc.), on grounds that from complete knowledge of the properties of sodium and chlorine in isolation, or in compounds different from that associated with sodium chloride, one could not deduce that salt will dissolve in water. But, she argues, it seems that dispositional properties are among the features that can be had by the components "in isolation", in which case the characteristic features and associated powers of sodium chloride will be deducible, after all:

> This case of emergence 'collapses' when [...] dispositional properties are included among the micro-level properties. [...] For example, one of the characteristic properties of sodium chloride is its solubility in water. Accordingly, sodium has the following dispositional property: to generate a compound that is soluble in water when combined with chlorine into sodium chloride. In Broad's terms, this property is a property of sodium "in isolation". [...] The emergent features of the whole R(A,B,C) can obviously be deduced from complete knowledge of the features of the parts A, B, and C and the knowledge that they are arranged as a whole R(A,B,C), so long as the features of the parts include these dispositional properties. (736)

Taylor sees a general problem here for accounts of strong emergence:

> [C]ases of emergence presuppose a distinction between micro-level and macro-level properties. For any purported case of emergence, there are properties that prima facie belong to the micro level, but if they are included in the micro level then the purported emergent fails to meet a necessary condition for emergent autonomy. I call these problematic properties *collapse-inducing properties* because when they are included in the micro level, the purported emergent effectively 'collapses', and yet it seems arbitrary to exclude them. [...] This is the problem of collapsing emergence (or, for short, the collapse problem). (732-733, emphasis in the original)

Indeed, what we might call the "dispositional move" poses a general threat to the viability of a powers-based conception of strong emergence. To start, while van Cleve and Taylor focus on Broad's "failure of deducibility" criterion, the intended import of that criterion was (as earlier observed) to track the fundamental novelty of a strongly emergent feature. Such fundamental novelty, according to the powers-based approach, is reflected in a strongly emergent feature's having powers not had by the lower-level physical feature upon which it depends (and indeed, by any lower-level physical feature or features). And notwithstanding that the dispositional features of the "isolated" lower-level entities at issue in van Cleve's and Taylor's discussions are, to use O'Connor's (1994) terminology, at various "removes" from either *P* or *S* (understood as above), nonetheless one might naturally suppose that such dispositions in some sense have the purportedly novel powers at issue, contra the intended fundamental novelty of a strongly emergent feature. Moreover, as Howell (2009) suggests, if one holds fixed that strongly emergent features are supposed to be physically unacceptable (as opposed to taking these to be physically acceptable in virtue of being

part of the lower-level base), then dispositional collapse might be seen as threatening the physical acceptability of the base features.

On the dispositional move O'Connor (1994) is again relevant, as is Shoemaker (2002, 2007). After presenting and (in our view, unsuccessfully) responding to the first version of the collapse objection, O'Connor discusses an alternative dispositional formulation of the objection, which he credits to Shoemaker (p.c.), according to which one can always insist that purportedly strongly emergent features are in fact "further (hitherto undetected) micro-properties" which are manifested only in certain complex circumstances. Shoemaker goes on, in his (2002) and (2007), to develop this suggestion, whereby the instantiation of seemingly strongly emergent features involves the manifestation of powers that are existent, but latent, at the micro-physical level. More specifically, Shoemaker distinguishes between "micro-manifest" and "micro-latent" powers of lower-level entities, and suggests that emergent features have ("Type-2") powers that are latent at the micro-physical level:

> When micro-entities are combined in an emergence engendering way, the resulting object will apparently have two sorts of micro-structural properties. One sort, call these provisionally Type-1 micro-structural properties, will consist of properties that can be specified entirely in terms of the micro-manifest powers of the constituent micro-entities together with how these micro-entities are related—i.e., in terms of what could be known about them prior to their entering into emergence engendering combinations. [...] The other sort, which I will provisionally call Type-2 micro-structural properties, will be properties that are specified in terms of all of the powers, micro-latent and micro-manifest, of the constituent micro-entities. [...] Type-2 micro-structural properties, although they are micro-structural, will be emergent properties. [...] If emergentism is false, manifest causal powers are the only ones the micro-entities have, and physical micro-

> structural properties are the only ones macro-objects have—and the other properties of macro-objects are realized in their physical micro-structural properties. (2002, 55)

As Shoemaker sees it, micro-latent features provide "a good understanding" of emergent phenomena that is compatible with physicalism (71); Gillett (2002) offers a similar account as "vindicating non-reductive physicalism as a viable position" (102). Interestingly, Shoemaker traces the view that emergent features are micro-latent to Broad (1925), who seems to have seen this as a different way of encoding the violation of composition laws and associated coming into play of "trans-physical" laws which he associated with strong emergence. In any case, on Shoemaker's dispositional version of the collapse objection, while there may be features which are only instantiated under certain complex circumstances, such features are not strongly emergent in the relevant sense of having fundamentally novel powers, not possessed by any physical base features.

The version of the dispositional move that Howell (2009) endorses is in some sense a generalization of Shoemaker's, in that Howell sees commitment to micro-latent properties as following from endorsement of any view on which strongly emergent features are metaphysically necessitated by base features:

> Let's grant to the emergentist that there is a genuinely new emergent property [S] which emerges necessarily from [P]. We can suppose, for example, that [S] is the property of having a phenomenal pain. It seems that any plausible version of necessitarianism will entail that properties are (at least) in part individuated by the properties they necessitate, be those properties emergent or otherwise. This might be because necessitarianism follows from one's view of properties, as in Shoemaker, or it might be because one is forced to this view of properties by one's necessitarianism. Either way, the result is that

> [P] is individuated in part by the disposition to give rise to [S]. (93, property names changed appropriately)

As previously noted, Howell moreover sees such dispositional collapse as undermining the supposed physical acceptability of the base features, given that strongly emergent features are supposed to be physically unacceptable. Whether (as per Shoemaker and Gillett) dispositional collapse is taken to show that strongly emergent features are compatible with physicalism, or whether (as per Howell) dispositional collapse is taken to show that strongly emergent features "pollute" the base-level goings-on, the viability of a powers-based account of strong emergence is called into question.

Again, certain responses that have been brought to bear on behalf of the strong emergentist against the dispositionalist move are less than satisfactory. After raising the collapse concern, van Cleve (1990) initially seems to dismiss it, then gestures at the possibility (applying to Broad's formulation, in particular) that restricting the base features to those that are manifested in non-emergence-engendering combinations—effectively, Shoemaker's "Type-1" micro-features—might do the trick:

> From such properties of the parts, may not all properties of the whole be deduced? The answer, of course, is yes; but it is also clear that if properties of this sort are admitted in the "supervenience base", the doctrine of anti-emergence (or mereological reducibility, as it might be called) becomes completely trivial. (Compare: I could maintain that all properties of everything in the universe are deducible from the properties of James van Cleve, provided you counted among my properties such items as "being such that the Eiffel Tower is 1,056 feet tall.") Clearly, some sort of anti-triviality stipulation is required. Perhaps the required work can be done by Broad's phrase "taken separately and in other combinations," for one could plausibly refuse to regard the property "forming a whole with such-and-such features when

> combined with chlorine" as a property of sodium taken separately. (223)

But to observe that the collapse objection poses a problem for the substantiality not just of strong emergence but also for its competing doctrines makes things worse, not better. Nor is it clear that Broad's qualification provides a basis for plausibly refusing to regard the property "forming a whole with such-and-such features when combined with chlorine" as a property of sodium taken separately; for it is commonly assumed (see, e.g., Martin and Heil 1998) that dispositions can be had by individuals even when the dispositions aren't being manifested: fragile vases don't have to break just because they are fragile. In that case, Broad's criterion does not rule out that this dispositional property could be had by sodium "taken separately".

Taylor considers another response—namely, to restrict lower-level features to be non-dispositional. But she maintains, plausibly enough, that this would be overly restrictive, since many uncontroversially lower-level physical features—e.g., having a mass of 5 g—are to some extent dispositional.[11] Indeed, some think (e.g., Mumford and Anjum,

[11] Taylor's preferred response in her (2015a) involves adoption of an alternative epistemological (and observer-relative; see her 2015b) conception of emergence as involving the unavailability of a certain kind of explanation: "A macro-level property p is emergent iff there is no available explanation of the fact that the following regularity holds of natural necessity: Whenever components A, B, C … n are combined in relation r, the resulting whole instantiates property p" (746). Given the explanatory principle that facts cannot explain themselves, such a conception avoids collapse; for it is characteristic of collapse-inducing features that they incorporate reference to the fact needing explanation, in which case they cannot explain that fact, and so the emergence of the associated feature is preserved. Taylor's response is not directly relevant to our project of assessing

2011) that all properties are dispositional, including so-called "sparse" properties of the sort lower-level features are supposed to be, which would render the response not just empirically problematic but self-undermining. A more sophisticated variation on the theme of this response grants that lower-level features may be dispositional, but distinguishes dispositions that are manifested in lower-level interactions from those that aren't, as in O'Connor and Wong's (2005) suggestion that "The difference that strong emergence makes is that what happens transcends the immediate [...] interactions of the microphysics" (669).[12] But this response makes strong emergence too easy to come by, since complex non-linear phenomena that all parties agree are physically acceptable also in some sense transcend immediate microphysical interactions.

Finally, O'Connor (1994) argues that the dispositional version of the collapse objection is implausible and *ad hoc*:

> While I have no argument to show that one cannot (in consistency) make such a move, it is, in my judgment, an implausible one. Why does such a micro-property make its presence known only in highly complex systems of a certain sort? How is it that such a fundamental property can be so causally isolated from other micro-properties so as to be discernible only in circumstances that are otherwise noteworthy only for the complex macro-properties which are instantiated? The presence of an emergent property is

whether a powers-based (and more generally, a metaphysical) account of emergence can avoid the collapse objection(s). See Skiles (2016) for a challenge to the explanatory principle upon which Taylor's strategy relies.

[12] A similar response is operative in Clark's (1999) claim that "if there are emergent powers, then the kind of micro-explanation that is the ambition of most physicalists, an explanation of the behavior of all objects in terms of micro-level properties and relations and micro-level laws, will be impossible" (309).

> by far the more natural assumption to make in the idealized circumstance depicted above, and the only motivation one could have for postulating a (rather elusive) micro-property is a very strong methodological principle to the effect that one is to avoid emergentist hypotheses at all costs, which by my lights is not a reasonable one.

In fact, we need to distinguish two readings of O'Connor's response. The first is along lines of his response to the first collapse concern, according to which it would be methodologically inapropos to suppose that phenomena instantiated only in highly complex systems are a matter of dispositional lower-level physical goings-on. This line of thought is uncompelling, not just because, as previously, there is nothing implausible or *ad hoc* about taking dispositions to produce complex behaviours to be present at the micro-level (as per cases of complex non-linear phenomena), but because dispositions typically "make their presence known" only when certain conditions are in place.

The second reading brings out, more specifically, the supposition that strongly emergent features or powers are not just novel (or quirky), but fundamentally novel. If these features or powers are indeed fundamental, and again manifest only in highly complex circumstances, then there is a methodological choice: either take the fundamentally novel feature to be a manifestation of a fundamental micro-level feature which for some reason only shows up at the macro-level, or take it to be strongly emergent. In that case, O'Connor suggests, given the fundamental nature of the property at issue, incorporating it into the physical laws would result in arbitrarily or unappealingly disjunctive physical laws, in which case the only reason to make the dispositional move would be on the *ad hoc* basis that strongly emergent properties are to be avoided at all costs. This line of thought does better, in our view, but is still less than compelling. To start, it is unclear whether a single, somewhat disjunctive system of laws is that much worse, from the perspective of theoretical virtues, than multiple non-disjunctive systems

of laws. Moreover, it is unclear that the physicalist need agree that the associated dispositional micro-level laws or features would just be disjunctive add-ons to the other posited micro-level laws and features; for perhaps (they might maintain) the fundamental goings-on are unified at a deeper level. At a minimum, more would need to be said to block this reply to O'Connor's response.

One last response to a dispositional version of the collapse objection is worth considering—namely, Skiles's (2016) suggestion that the collapse of an emergent feature *F* can be avoided by appeal to the notion of a 'generic essence'—not of *F*, but of the dependence base features of *F*, taken collectively. More specifically, the suggestion is that *F* not appear in the generic essence of the collection of features upon which *F* depends: "to solve the collapse problem, we demand the collection of features that constitute a micro-level base of an emergent features [F] be pure of [F]" (840). Two concerns attach to this suggestion, in our view. First, the notion of essence remains, for many, metaphysically opaque; and while some handle on this notion, as applying to objects, can be gained by appeal to the notion of essential properties, the present appeal to the essence of properties cannot, it seems, proceed in that fashion, but must rather be taken to be primitive (encouraging opacity). Second, as discussed in Wilson (2005), certain live accounts of broadly scientific properties as essentially individuated by the laws into which they enter (as per, e.g., Shoemaker 1980 and Swoyer 1982) entail that the essences of micro-level base feature or features of an emergent feature *F* would fail to be "pure" of *F*, in which case collapse remains a threat.[13]

[13] That said, the strategy we discuss in Section 4.2 offers a means of blocking an essence-based route to collapse.

4. Four responses to the collapse objection

The general concern posed by the collapse objection is that, either because the lower-level dependence base feature *P* at least nomologically necessitates higher-level feature *S*, or because there are lower-level features properly seen as dispositions to produce *S*, there is no way for *S* to have a fundamentally novel power, as required by a powers-based account of strong emergence. (Henceforth, we'll often leave the qualifier "fundamentally" implicit.) We now present and defend four different responses to the collapse objection, each of which consists in highlighting an independently plausible strategy that, we argue, can be used to make sense of the novelty of powers of a strongly emergent feature, and hence of such features themselves, in such a way as to preserve the intended contrast with physicalism.

4.1 Direct vs. indirect powers

The first line of response is directed specifically at the power inheritance version of the collapse objection, and proceeds by way of distinguishing between direct and indirect having of powers. Here the strong emergentist can grant that while in cases of strong emergence there is a rough or loose sense in which *P* or other lower-level physical features inherit any of *S*'s purportedly new powers (either in being at least nomologically sufficient for any such power, or in being disposed to give rise to *S*), in a stricter sense no lower-level feature, *P* or any other, has exactly such a power, or has such a power in the same way as *S*. The suggestion is that *S*'s novel power or powers are not had or manifested by lower-level features in the same direct or immediate way as they are had or manifested by *S*. Notwithstanding that *P* synchronically

necessitates *S*, *P* has these powers only in that *P* is a precondition, in the circumstances, for *S*, which is the more direct locus of the power.[14]

Such a strategy seems well-motivated, given the strong emergentist understanding of lower-level physical goings-on as being precisely such metaphysical preconditions for the instantiation of distinct strongly emergent features. We moreover observe that there are two ways to substantiate the intuition and associated strategy.

First, the strong emergentist can appeal to an analogy to temporally extended causal chains: even if each link in the chain is, in the circumstances, nomologically sufficient for the next link, one can nonetheless distinguish more and less direct causes of the end result. For example, from the fact that a person *P* lights (or could light) a fuse leading an explosion, it doesn't follow that the explosion isn't a novel phenomenon, or that there is any but an indirect sense in which person *P* has the power to produce an explosion of this type. Similarly, the strong emergentist can maintain, *P* is metaphysically, if not temporally, antecedent to *S* in the chain of feature instantiations potentially leading to the effect associated with *S*'s novel powers.

Second, the strong emergentist can appeal to an analogy to sets and subsets to make the notion of the synchronic yet indirect having of a power more precise, in order to argue that there are in fact different circumstances associated with *S* and with *P* vis-à-vis the having of the power at issue. As is uncontroversial, powers are individuated, in part, by the circumstances in which they manifest and contribute to the production of a given effect; but just as we can distinguish between a set and its subsets at a time, there seems to be no in-principle reason why

[14] As above (note 10), Yates's (2016) response to what he calls the grounding objection is structurally similar to our response here, in that he takes the having of a power in virtue of having *S* and the having of a power in virtue of having *P* to be or involve different relations.

we cannot distinguish different sets of circumstances associated even with a single temporal interval (instantaneous or extended). In particular, the strong emergentist can say that *P* has the power to contribute—at least nomologically, if not causally—to the production of *S*, in circumstances *K* which do not include the presence of *S*. In virtue of having this power, *P* indirectly has the power to contribute to causing anything that *S* can cause. By way of contrast, *S* has at least one power—its novel power(s)—directly, which is or can be manifest in circumstances *K'* which, whatever else they might be or include, do not encode the absence of *S*.

Perhaps the main concern with the direct/indirect having (or bestowal) strategy is that there may be some indeterminacy in what counts as direct (as opposed to indirect) having or manifestation of a power, just as there might be indeterminacy as regards what counts as the most temporally proximal (to a given effect) link in a causal chain. Here the strong emergentist has three responses. First, as per usual, the presence of seeming indeterminacy and associated borderline cases needn't undermine the usefulness of a given distinction. Second, the strong emergentist might maintain that any indeterminacy here is merely epistemic (following, e.g., Williamson 1994). Third, there have recently come available two strategies for accommodating indeterminacy in properly metaphysical (as opposed to merely semantic or epistemic terms): first, the metaphysical supervaluationism endorsed by Akiba (2004), Barnes (2010), Barnes and Williams (2011), and others; second, the determinable-based account endorsed by Wilson (2013a; 2017), recently applied by Bokulich (2014) and Wolff (2014) to the case of quantum metaphysical indeterminacy.

4.2 Lightweight vs. substantial dispositions

A variation on the previous strategy serves also to block the dispositional feature inheritance version of the collapse objection. We start by

observing that strong emergentists will generally agree that in some broad sense, physical features have latent powers or dispositions to bring about emergent features. As O'Connor and Wong (2005) put it:

> [I]t is true in an emergentist scenario that everything that occurs rests on the complete dispositional profile of the physical properties prior to the onset of emergent features. For the later occurrence of any emergent properties are contained (to some probabilistic measure) within that profile, and so the effects of the emergent features are indirectly a consequence of the physical properties, too. (669)

But the intended sense in which the physical base features have dispositions to bring about strongly emergent features here is lightweight, signifying just that the base features are *preconditions* for the occurrence of the fundamentally novel strongly emergent feature, contra physicalism. Indeed, pace Shoemaker's reading of Broad, Broad's assumption that emergence has anti-materialist implications indicates that in allowing that micro-physical entities have latent powers that become manifest when in emergence-engendering combinations, he has such a lightweight dispositional sense in mind.[15] This lightweight understanding of the sense in which there might be lower-level dispositions to bring about strongly emergent features doesn't undercut the core claim of the strong emergentist—namely, that some higher-level features have powers that are fundamentally novel, in a way incompatible with physicalism. And more generally, the strong emergentist can maintain that collapse would be a threat only if there

[15] Hence it is that Broad does not feel the need to rule out the micro-latent interpretation in taking apparent violations of composition laws to have anti-materialist implications.

was independent good reason to think that the dispositions at issue in the collapse objection were substantially located at the lower-level.[16]

Is there good reason to think that the micro-level dispositions at issue in the collapse objection are substantive rather than lightweight? We've seen two suggestions along these lines; but as we'll now argue, neither is compelling.

First, as above Howell (2009) suggests that if the strong emergentist maintains that strongly emergent features are metaphysically necessitated by base features, then this comparatively strong modal connection is best understood as indicating that the bringing-about of a strongly emergent feature is essential to—part of the nature of—the base feature at issue. But, to start, a strong emergentist needn't maintain that base features metaphysically necessitate strongly emergent features;[17] in any case modal connections are notoriously insufficient unto the task of tracing essential properties (see, e.g., Fine 1994); and finally, even if it is essential to certain base features that their instantiation in certain circumstances brings about a strongly emergent feature (as those who take scientific properties to be individuated by all the laws into which the properties enter maintain), the strong emergentist can again maintain

[16] Meehl and Sellars (1956) appear to endorse a version of this response against Pepper's (1926) 'variable-based' version of the collapse objection, in saying that "Pepper implies that there could be no such thing as a regularity in which certain characteristics supervene upon other characteristics but in which the lower-level characteristics were not adequate to explain the occurrences on their level".

[17] Howell's focus on metaphysical necessitation reflects his desire to vindicate a supervenience-based approach according to which strongly emergent features supervene with nomological but not metaphysical necessity on base features; but a strong emergentist who follows Howell in thinking that there is a modal distinction here needn't follow him in thinking that this is all there is to the dispute between physicalists and strong emergentists.

that all this shows is that it can be essential to a lower-level feature that it be dispositional, in the lightweight sense, for a strongly emergent feature.

Second, as above the proponent of the collapse objection might maintain (as we observed against O'Connor's suggestion that lower-level laws incorporating reference to fundamentally novel strongly emergent features would be unsatisfactorily disjunctive) that the fundamental goings-on are unified in such a way as to reveal that the dispositions at issue are possessed by micro-features in substantive as opposed to lightweight fashion. But here we think the strong emergentist is within their rights to respond, "Show me the money".

Indeed, the burden on the proponent of the collapse objection here is quite heavy, since they need to make a case that lower-level physical phenomena are properly seen as substantively having the dispositions in question, even though strongly emergent phenomena—all parties agree—bear no aggregative or obviously compositional relationship to the lower-level features treated by physics. Perhaps the most promising route here would be one appealing to the unity of fundamental interactions; but—to take a point from Howell—in this case it would be unclear that the resulting lower-level base would be physically acceptable, and so no real advance on characterizing the contrast between physically acceptable and strongly emergent features would have been gained.

4.3 Powers relativized to fundamental interactions

Attention to fundamental interactions gives rise to a third response to the collapse problem, according to which powers are relativized to sets of fundamental interactions, making room for higher-level features to have powers that are in some sense new, as *SE* requires (see Wilson 2002). To start, it is a scientific truism that powers are dependent on or grounded in (to speak schematically), in some way that deserves further

attention, one or more fundamental forces or interactions.[18] The power of being able to bond with an electron, in circumstances where one is in the vicinity of a free electron, is grounded in the electromagnetic (or electroweak) interaction, as opposed to the strong nuclear or gravitational interactions. The power of being able to fall when dropped, in circumstances where one is poised above Earth's surface, is grounded in the gravitational force, as opposed to the other fundamental forces in operation. The power of being able to bond with other atomic nuclei in a stable configuration is grounded in the strong nuclear interaction, as opposed to the electromagnetic, weak, or gravitational interactions. The power of being able to sit on a chair without falling through it is grounded (at least) in the gravitational and the electromagnetic interactions. And so on. In providing a constitutive basis for the powers bestowed by properties, fundamental interactions explain, organize and unify vast ranges of natural phenomena.

The metaphysics of fundamental interactions, treating both what these are and how they serve as a basis for powers, is an underdeveloped area of research. In her (forthcoming a), Wilson makes a start on this interesting issue, suggesting that fundamental interactions are plausibly understood as second-order "multi-track" dispositions: that is, dispositions of fields or regions of spacetime which are manifest in circumstances where the interaction comes into play, and where what is manifested in these circumstances are properties of the field that may or may not be identified with objects (e.g., photons, electrons, etc.) or other entities (e.g., systems, events) and which in any case are associated with powers to contribute to the production of certain effects, when certain other circumstances are in place. On this view, powers of ordinary

[18] Forces involve pushes or pulls; interactions include non-force goings-on such as particle decays or exchanges.

objects or their ultimate non-field substantial components (e.g., protons and electrons) are effectively local manifestations of more fundamental powers of one or more fundamental fields.[19] Obviously, much more remains to be said here. Independent of the metaphysical details, however, given that the claims that there are fundamental interactions and that powers (of ordinary objects, systems, and events, etc.) are metaphysically dependent on such interactions are claims in unassailably good scientific standing, we appear to be within our rights to speak of a feature's having (or not having) a power, relative to a given set of fundamental interactions.

Of course, physicalists of whatever stripe think that *physical* interactions are the *only* fundamental interactions there are, while (as McLaughlin 1992 emphasizes) the strong emergentist thinks that, in addition, there are one or more non-physical "configurational" fundamental interactions. [20] Strong emergentists can thus grant that,

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[19] As such, powers of ordinary objects are not grounded in fundamental interactions in a way that reductively dispenses with powers; this doesn't strike us as problematic, since the goal wasn't to dispense with powers but rather to explain why the powers of ordinary broadly scientific goings-on are standardly associated with so-called fundamental interactions.

[20] What counts as a fundamental physical interaction will depend on the operative notion of the physical. On Wilson's (2006) account, the physical entities are those treated, approximately accurately, by present (in the limit of inquiry, future) physics, and which are not fundamentally mental (i.e., are not such as to individually have or bestow mentality); on this conception, fundamental interactions coming into play at the level of complexity of mentality would count as non-physical. Wilson argues that this conception of the physical suffices as an operative basis for formulating theses such as physicalism and strong emergentism, at least for the live cases of qualitative, normative, and agential mentality that represent the remaining "hard problems" so far as the truth of physicalism is concerned.

taking both physical and non-physical interactions into account, *P* has every power *S* has; but coherently maintain that, when *S* is strongly emergent, it will have powers that are "new" relative to those powers of *P* grounded only in fundamental physical interactions. Such a conception clarifies the sense of novelty at issue in the new power condition in *SE*, making explicit that this novelty—hence strong emergence itself—is *interaction-relative*, along the following schematic lines:

Interaction-relative Strong Emergence (*Interaction-relative SE*): Feature *S* is strongly emergent from feature *P* relative to the set {*F*} of fundamental physical interactions, just in case (i) *S* broadly synchronically depends on *P*, and (ii) *S* has at least one power that is not identical with any power of *P* that is grounded only in the fundamental interactions in {*F*}.

Condition (i) again encodes satisfaction of the dependence condition, minimally understood as involving nomological sufficiency in the circumstances, while condition (ii) refines the new power condition in *SE*, making explicit that the sense of "new" at issue adverts in part to a fundamental interaction that is new relative to the set of physical fundamental interactions.[21] Again, the notion of "grounded in" at issue here is intended as schematic for some or other specific metaphysical relation (perhaps that of being a manifestation of a multi-track second-order disposition of one or more fundamental fields).

An interaction-relative conception of strong emergence has a number of advantages. First, the conception is clearly in the spirit of the original British Emergentist suggestion that strong emergence involves what "we

[21] *Interaction-relative SE* can be applied, more neutrally, to characterize strong emergence as relative to any given set {*F*} of fundamental interactions (see Wilson 2002); given our target here, we build in that the interactions at issue are the fundamental physical interactions.

may call 'configurational forces': fundamental forces that can be exerted only by certain types of configurations of particles" (McLaughlin 1992: 52). Second and relatedly, it clearly distinguishes dependent features which should be characterised as "over and above" their base features in a way at odds with physicalism from those that are not: if a dependent feature's instantiation and (any) associated powers require the existence of a fundamental interaction beyond the fundamental physical interactions, then the feature is physically unacceptable; otherwise not. Moreover, as Wilson (2002) notes, the history of science suggests an operative criterion for when a new fundamental interaction should be posited. In particular, scientists posited the weak nuclear interaction in response to seeming violations of conservation of energy: rather than reject the conservation law, they introduced another fundamental interaction as making up the difference. Third, that new fundamental interactions are posited in response to seeming violations of conservation laws suggests that even in the presence of an insuperable explanatory gap, a given phenomenon might not be appropriately deemed strongly emergent—if, in particular, the phenomenon does not involve any such seeming violations. This is useful, especially given that drawing metaphysical conclusions from (merely) epistemological failures is a fraught exercise, both in general and in light of the fact that some non-linear phenomena might be thought to involve insuperable explanatory gaps, notwithstanding reasons to think such phenomena are physically acceptable.

Fourth and most importantly for present purposes, *Interaction-relative SE* makes room for there to be strong emergence in the face of the collapse objection. To start, even if, taking all fundamental interactions into account, features of the composing system in some sense inherit all the powers of any features they (at least nomologically) necessitate, it remains that composite features may be associated with powers that are "new", in not being grounded only in the set of physical fundamental interactions. Properly relativized, the novel powers of strongly emergent

features do not collapse. Relatedly, relativizing powers to fundamental interactions provides a principled basis for distinguishing dispositions expressing mere preconditions for the occurrence of strongly emergent features from those that more directly or substantively have the novel powers at issue. This distinction in turn provides a principled basis for maintaining, contra Howell, that the novel powers associated with strongly emergent features do not "pollute" the lower-level physical base, since the physical powers are those grounded just in fundamental physical interactions. As such, *Interaction-relative SE* avoids all versions of the collapse objection.

We see three potential concerns with *Interaction-relative SE* and/or the associated response to the collapse objection, each of which is answerable, as follows. First, one might object that a relativized conception of emergence is somehow problematic; but without further exposition we don't see a deep worry here. Second, one might be concerned that a relativized conception would fail to track anything metaphysically interesting or "joint-carving", as with conceptions of emergence on which this is relative to what is "surprising", or Taylor's alternative (2015) conception in terms of what is (perhaps only presently and contingently) scientifically unexplained. *Interaction-relative SE* doesn't have this problem, however: new fundamental interactions are interesting and joint-carving, if any natural phenomena are; and that powers are relativized to sets of such interactions seems to be an empirical, not epistemic, fact. Third, one might be concerned that *Interaction-relative SE* requires realism about fundamental forces or interactions, but in the absence of reasons to think such notions are metaphysically problematic, the concern is not pressing. As above, there is a line of thought on which fundamental interactions are fundamental dispositions of fields (namely, dispositions to give rise to further dispositions of non-field entities), and dispositions are not just familiar but moreover admit of more or less metaphysically lightweight interpretations. In any case, and again independent of exactly how

fundamental interactions should be metaphysically understood, participants to the debates over physicalism or strong emergence typically take a fallibilist realist stance towards the posits of science; and if there is any scientific posit in good standing, it would seem to be that of a fundamental interaction.[22]

4.4 Strongly emergent objects

The fourth response to the collapse problem proceeds via the supposition that a strongly emergent feature must be instantiated in a new object (or other entity or entities; we stick with "object" for simplicity), different from the lower-level object (or plurality of objects, as the case may be) bearing the lower-level base feature. As we will see, there are several different reasons why one might suppose that strongly emergent features must be instantiated in new objects. First, though, note that on this supposition, collapse will plausibly be blocked: if no lower-level (here, physical) object is suited to be the bearer of the strongly emergent feature, and given that what is distinctive about such a feature is its having of a fundamentally novel power, it will likewise be plausible that the lower-level dependence base feature which is suitably born by the lower-level object does not have the power.

[22] The notion of a force is somewhat more open to question, in that what were in the past characterized as Newtonian forces are now understood to involve, more fundamentally, quantum-theoretic exchanges of bosons (photons in the case of electromagnetism, gluons in the case of the strong nuclear interaction, and so on); Newtonian forces have also been challenged as being unneeded intermediaries between propertied particulars. There is a case to be made that Newtonian forces are real, even if non-fundamental, qua special science entities (see Wilson 2007); but in any case Newtonian forces are not what is at issue in *Interaction-relative SE*.

Indeed, the suggestion that strongly emergent properties are had by new objects is not uncommon, though so far as we are aware, we are the first to use this suggestion as a means of blocking the collapse objection. We will start by briefly canvassing three of these suggestions and their motivations, then present and develop a new motivation for thinking that strongly emergent features must be had by new objects, drawing on the thesis (following Baysan 2016) that features, and more specifically properties, have their powers derivatively on the powers of their bearers.

There are at least three accounts in the literature whereby the emergence of a property is thought to require a new object (or substance). First, O'Connor and Jacobs (2003) suggest that bearers of some strongly emergent properties—in particular, persons with strongly emergent conscious properties—must be new entities, over and above their composing parts, on grounds that a conscious subject with holistic mental states requires a "thisness", or "particularity" that the parts of a conscious subject cannot have, even collectively. In this respect, they claim, persons are unlike mereological sums or other complex objects which derive their particularity from their parts.

Second, Nida-Rumelin (2006) endorses a form of what she calls "emergent substance dualism", again associated with the need for there to be a distinct subject of conscious experience:

> Suppose consciousness arose for the first time on our planet in the moment in which a particular quite primitive organism somewhere in some ocean began to feel comfortable warmth when it moved by chance into warmer water. ... [A]n astonishing and radical change took place in this moment. But let us ask what exactly it is that makes the change a radical change and a change that deserves amazement. It is not the instantiation of the particular phenomenal property of feeling warmth. What makes the change amazing has nothing to do with this special phenomenal character. Rather, the astonishing fact is this: since, as we assumed, a feeling of warmth has occurred, there is

> "someone" who feels the warmth. The fact that "someone" came into existence is the astonishing aspect of the change and the aspect that makes the change a radical change. Before the first occurrence of a faint feeling, no one was on our planet to experience the world. In that moment, a subject capable of experience came into existence (274).

Finally, Heil (2012, Chapter 2) maintains that emergent properties require new substances, on the grounds that the bearers of properties must be simple substances, such that any emergent properties there might be would require an emergent simple substance, seemingly dependent on complexes of lower-level simple substances, in order to be instantiated.

Each of these views is consonant with taking strongly emergent features to bring new objects in their wake, and so far as we can tell, each provides at least a potential basis for responding to the collapse objection (modulo certain concerns that we will address down the line).

We turn now to a new motivation for taking strongly emergent features to require new objects, which draws on and extends the discussion in Baysan (2016). Baysan notes that, notwithstanding that powers are usually attributed to properties, one might reasonably maintain that talk of properties as having powers is derivative on the powers of objects instantiating the properties:

> What do we mean when we attribute powers to properties? [...] Being knife-shaped has the power to cut bread—conditionally on being instantiated with certain other properties, of course. When we attribute this power to the property of being knife-shaped, do we really mean that the property itself has this power? Unless we want to identify properties with bundles of powers, I don't think that we have any good reason to give an affirmative answer to this question. Properties don't cut bread. Their bearers might. To generalize, properties don't (literally or fundamentally) have powers; their bearers do. (386)

Such a view, in a strong emergentist context, might be seen as suggesting that the fundamentally novel powers associated with a strongly emergent feature are in the first instance powers of a fundamentally novel object suited to instantiate the feature in question. This allows for a principled response to the collapse problem: given that in a case of strong emergence, the strongly emergent feature *S* is understood as having a fundamentally new power, and given that the powers of features are derivative on the powers of objects, the strong emergentist can reasonably maintain that a fundamentally novel object, different from whatever lower-level object is required to be the bearer of *P,* is required to be the bearer of *S*.

In what sense are the bearers of *S* and *P* distinct? To start, the form of distinctness here is importantly different from that at issue in Gillett's (2002, 2003) "dimensioned" account of physical realization (i.e., weak emergence). On Gillett's view, weak emergence is a one-many relation involving different objects: an emergent feature of an object is instantiated in virtue of the multiple features of the constituent proper parts of that object. Gillett's illustrative case is that of the hardness of a diamond being emergent from the features (properties and relations) of the diamond's constitutive atoms. Unlike Gillett's account, the present new object strategy reflects the idea that even if (as is usually assumed) emergence is a one-one relation between one higher-level feature, *S*, and one base feature, *P*, these features might not be instantiated by the very same object, and that this difference in objects in turn blocks the collapse of higher-level powers. Hence while the new object strategy, like Gillett's many-one account of weak emergence, dispenses with the common assumption (reflected, e.g., in the standard formulations of strong supervenience, as a dependence relation holding between different properties of the same object) that emergent and base features are instantiated in the same object, it does not require the base property or properties to be had by the proper parts of the object having the

emergent property.[23] Rather, it suggests that there are *spatially coincident* non-identical objects. One object is the bearer of the base feature, and another, spatially coincident, object is the bearer of the strongly emergent feature.

Effectively, this new object strategy turns the collapse objection on its head: given that strong emergence requires a novel power, and given (as per Baysan 2016) that powers of features are derivative on powers of their bearers, *SE* requires a novel object to have the novel power, which is then associated with the emergent feature *S*.[24] Indeed, the strong emergentist can implement the strategy even if they don't agree with Baysan that the powers of features are generally or always derivative on the powers of objects. They can simply maintain—reasonably, it seems to us—that new objects are required to be the bearers of any *fundamentally novel* powers or features there might be.

An advantage of the new object strategy, however motivated, is that, as with the strategy explored in 4.3, it provides the basis for a clear

[23] That said, the assumption that base and emergent features are instantiated in the same object is not universally shared, even among those advocating a one-one account of physical realization (weak emergence). Hence, for example, while Gillett characterizes one-one forms of realization as "flat", both Wilson and Shoemaker allow that on a "subset of powers" approach, weakly emergent and base features might be instantiated in different objects; and similarly, Wilson (2011) suggests, for strongly emergent and base features.

[24] This version of the new object strategy thus contrasts with a recent proposal by Caves (2015) aimed at allowing even a mereological nihilist (that is, someone who believes that there are no composite objects) to accommodate emergent features, via what he calls the "plural instantiation strategy", on which composite objects are not needed to instantiate emergent features, since mereological simples can "collectively" do so. Caves' suggestion also departs from Heil's (2012) view that emergent properties must be instantiated in emergent simple substances.

characterisation of "over and aboveness". Mereological composition is sometimes said to be "ontologically innocent" (e.g. Lewis 1991), such that mereological wholes are "nothing over and above" their parts, taken together. Whether mereology is really ontologically innocent in this sense is controversial (see, e.g., Merricks 2003). In any case, the new object strategy offers a clear sense in which, in cases of strong emergence, a higher-level whole is "over and above" the lower-level parts upon which it depends (and which, either relationally or collectively, have the lower-level base feature *P*), vindicating and substantiating a common characterization of emergence according to which the whole is more than the sum of its parts.

Again, certain concerns might be raised against the new object strategy, each of which is answerable, as follows. First, one might be concerned that the strategy is committed to the existence of distinct but spatiotemporally coincident objects. Supposing so, we think that the strong emergentist is within their rights to shrug their shoulders. The possibility of spatial coincidence is one of the many responses to puzzles of change and material composition; and while no solution to such problems remains uncontested, the claim that there can be spatiotemporally overlapping objects, as in the case of statues and lumps, persons and bodies, and so on, has the weight of both intuition and science (insofar as the special sciences, including chemistry and biology, appear to posit objects that are both different from yet spatiotemporally coincident with lower-level physical objects or other entities) on its side.

A second concern with the new object strategy is that it avoids the collapse objection only by giving rise to an "explosion" objection—namely, by committing the strong emergentist to a form of substance dualism, contra the traditional supposition that strong emergentism is a

substance monist, and moreover, a substance physicalist, view.[25] Indeed, as above, Nida-Rumelin (2006) sees her "new object" view of strongly emergent states of consciousness as involving substance dualism, in being committed to distinct objects instantiating mental properties and physical properties, respectively. Hence one might wonder whether the new object strategy shifts strong emergence too far to the dualist end of the spectrum.[26]

The proponent of the new object strategy has two lines of response to this concern. First, they can deny that from the mere positing of a new *object* a new *substance* is thereby posited. To start, the claim that all and only objects are substances is controversial, and may be rejected. For example, Lowe (1998, 181) argues that some entities (e.g., surfaces, holes, heaps, events) are objects, in being countable and in having determinate identity conditions, but are not substances, since incapable of independent existence.[27] More generally, on a conception of substance as capable of independent existence, a strongly emergent object does not count as a substance, since such an object is, by assumption, dependent on whatever object or objects are the proper bearers of the base feature. As such, we are not persuaded that the new object strategy as a response to the collapse problem leads to substance dualism.

To be sure, those like Nida-Rumelin and Heil, who are explicit in taking emergent features to bring new substances in their wake, cannot

[25] See Sartenaer (2013), however, for a criticism of taking strong emergentism to be a "middle ground" between physicalism and substance dualism/pluralism.

[26] The explosion problem is reminiscent of some arguments that Schneider (2012; 2013) has advanced against property dualism. She argues that property dualists (including non-reductive physicalists) must reject substance monism, as there is no viable theory of substance which makes it possible for a purely physical substance to have a non-physical property.

[27] Thanks to Michele Paolini Paoletti for pointing this out.

endorse the first response to the explosion concern. They can endorse the second response, however. Here one grants that a strongly emergent object counts as a new (type of) substance, and moreover one that is in some sense non-physical, but maintains that notwithstanding the traditional characterization of strong emergence as a form of substance monism, what is most important is that viable forms of such emergence suitably contrast with views on which the additional substances or associated subjects of strongly emergent features are immaterial or otherwise extremely different from physical substances. A commitment to strongly emergent objects doesn't entail anything of this sort. Indeed, the assumed broadly synchronic dependence of strongly emergent objects and features on lower-level physical objects and features is typically offered as a basis for ruling out serious Cartesian forms of substance dualism. Hence it is that both Lowe and Nida-Rumelin characterize their substance dualism as "non-Cartesian", in failing to involve Descartes' somewhat idiosyncratic claims about material and immaterial substances.

Finally, it is worth noting that although the new object strategy supposes that fundamentally novel features and powers require new objects to be their bearers, it doesn't thereby follow that having strongly emergent features or novel powers is *required* for a new object to emerge. Perhaps—though this is a story for another day—weakly emergent features also (sometimes or always) require new objects, having a distinctive subset of the powers of the base entities/features, to be their bearers.

5. Concluding remarks

We have argued that there are at least four different and independently motivated (though, so far as we can see, compatible) strategies for responding to the collapse objection, as directed at a powers-based account of such emergence, in particular, corresponding to four different distinctions: first, a distinction between the direct and indirect having of powers; second, a distinction between lightweight and substantive dispositions; third, a distinction between powers grounded (at least partly) in a new non-physical fundamental interaction and those grounded only in fundamental physical interactions; fourth, a distinction between the objects bearing the novel powers at issue and those that don't. At least so far as the collapse objection is concerned, strong emergence remains a viable live option for metaphysically accounting for many of the existing "hard problems" in the philosophy of science and mind.

To be sure, nothing we have said here prevents someone from maintaining that even if strong emergence is not incoherent, one should nonetheless maintain that seemingly strongly emergent features or powers collapse (as per the dispositionalist move, in particular), either because one is inclined towards physicalism or physicalist accounts of higher-level causation (as are Shoemaker and Gillett), or because the strategies involve distinctions or posits to which one prefer not to be committed, or because such a view would be in some sense more parsimonious, or what-have-you. While appreciating the possibility of these further responses, we see these as more properly concerning the question of whether, all empirical and philosophical things considered, there is any strong emergence. Our goal here has been the more limited one of showing that we can make sense of strong emergence, so that the question of whether there is any such emergence—and more generally, the traditional and contemporary debate between physicalists and

strong emergentists, as their best naturalistically acceptable rivals—can be seen as suitably substantive.

Faculty of Philosophy, University of Oxford, Oxford, UK
Email: umut.baysan@outlook.com

Department of Philosophy, University of Toronto, Toronto, Canada
Email: jessica.m.wilson@utoronto.ca

REFERENCES

Akiba, Ken, 2004, "Vagueness in the world", *Noûs,* 38:407-429.

Armstrong, David, 1997, *A World of States of Affairs*, Cambridge: Cambridge University Press.

Baker, Lynne R., 2000, *Persons and Bodies: A Constitution View*, Cambridge: Cambridge University Press.

Barnes, Elizabeth, 2010, "Ontic Vagueness: A Guide for the Perplexed", *Noûs,* 44:601-627.

Barnes, Elizabeth & Williams, J. Robert G., 2011, "A Theory of Metaphysical Indeterminacy". In: Karen Bennett & Dean W. Zimmerman (eds.), *Oxford Studies in Metaphysics, Volume 6*, Oxford University Press, pp. 103-148.

Baysan, Umut, 2015, "Realization Relations in Metaphysics", *Minds and Machines,* 25:247-260.

Baysan, Umut, 2016, "An Argument for Power Inheritance", *The Philosophical Quarterly,* 66:383-390.

Bernstein, Sara, & Wilson, Jessica, 2016, "Free Will and Mental Quausation", *Journal of the American Philosophical Association,* 2:310-331.

Bokulich, Alisa, 2014, "Metaphysical Indeterminacy, Properties, and Quantum Theory", *Res Philosophica*, 91:449-475.

Boyd, Richard, 1980, "Materialism without Reductionism: What Physicalism does not Entail". In: Ned Block (ed.), *Readings in the Philosophy of Psychology, Volume 1*. Harvard: Harvard University Press, pp. 1-67.

Broad, Charles D., 1925, *The Mind and Its Place in Nature*, London: Routledge & Kegan Paul.

Caves, R. L., 2015, "Emergence for Nihilists", *Pacific Philosophical Quarterly,* 97:1-27.

Chalmers, David, 1995, "Facing Up to the Problem of Consciousness", *Journal of Consciousness Studies*, 2:200–19.

Chalmers, David, 1996, *The Conscious Mind,* Oxford: Oxford University Press.

Chalmers, David, 2006, "Strong and Weak Emergence". In: P. Clayton and P. Davies (eds.), *The Re-emergence of* Emergence, Oxford: Oxford University Press, pp. 244-55.

Clarke, Randolph, 1999, "Nonreductive Physicalism and the Causal Powers of the mental", *Erkenntnis,* 51:295-322

Crane, Timothy, 2001, "The Significance of Emergence". In: C. Gillett and B. Loewer (eds.), *Physicalism and Its Discontents,* Cambridge: Cambridge University Press, pp. 207-224.

Davidson, Donald, 1970, "Mental Events". In: L. Foster and J. W. Swanson (eds.), *Experience and Theory*, Amherst, MA: University of Massachusetts Press, pp. 79-101.

Engelhardt, Jeff, 2015, "Property Reductive Emergent Dualism" *Philosophia,* 43:63-75.

Fine, Kit, 1994, "Essence and Dependence", *Philosophical Perspectives,* 8:1-16.

Gillett, Carl, 2002, "The Dimensions of Realization: A Critique of the Standard View", *Analysis,* 62:316-323.

Gillett, Carl, 2003, "The Metaphysics of Realization, Multiple Realizability, and the Special Sciences", *The Journal of Philosophy,* 100:591-603.

Hall, Ned, 2004, "Two Concepts of Causation". In: J. D. Collins and N. Hall (eds.) *Causation and Counterfactuals*, Cambridge, MA: MIT Press, pp. 225-276.

Heil, John, 2012, *The Universe as We Find it*, Oxford: Oxford University Press.

Heil, John, and Martin, C. B., 1999, "Rules and Powers", *Philosophical Perspectives,* 12:283-312.

Horgan, T., 1993, "From Supervenience to Superdupervenience: Meeting the Demands of a Material World", *Mind*, 102:555-586.

Howell, Robert, 2009, "Emergentism and Supervenience Physicalism", *Australasian Journal of Philosophy*, 87:83-98.

Humphreys, Paul, 1997, "How Properties Emerge", *Philosophy of Science,* 64:1-17.

Kim, Jaegwon, 1998, *Mind in a Physical World*, Cambridge, MA: MIT Press.

Kim, Jaegwon, 1999, "Making Sense of Emergence", *Philosophical Studies,* 95:3-36.

Kim, Jaegwon, 2006, *Essays in Metaphysics of Mind,* Oxford: Oxford University Press.

Lewis, David, 1991, *Parts of Classes*, Oxford: Blackwell.

Lowe, E. J., 1998, *The Possibility of Metaphysics: Substance, Identity, and Time,* Oxford: Oxford Clarendon Press.

Lowe, E. J., 2006, "Non-Cartesian Substance Dualism and the Problem of Mental Causation", *Erkenntnis,* 65:5-23.

Lowe, E. J., 2013, "Substance Causation, Powers, and Human Agency". In: S.C. Gibb et. al. (eds.), *Mental Causation and Ontology*, Oxford: Oxford University Press, pp. 153-172.

McLaughlin, Brian, 1989, "Type Epiphenomenalism, Type Dualism, and the Causal Priority of the Physical", *Philosophical Perspectives,* 3:109-135.

McLaughlin, Brian, 1992, "The Rise and Fall of British Emergentism". In: A. Beckerman, et. al. (eds.), *Emergence or Reduction? Essays on the Prospects of Non-Reductive Physicalism*, Berlin: De Gruyter, pp. 49-93.

Meehl, Paul E. and Sellars, Wilfrid S., 1956, "The Concept of Emergence". In: H. Feigel and M. Scriven (eds.), *Minnesota Studies in the Philosophy of Science, Volume I: The Foundations of Science and the Concepts of Psychology and Psychoanalysis*: 239-252.

Merricks, Terence, 2003, *Objects and Persons,* Oxford: Oxford University Press.

Mumford, Stephen, & Anjum, Rani Lill, 2011, *Getting Causes from Powers*, Oxford: Oxford University Press.

Nagel, Thomas, 1974, "What is it Like to be a Bat?", *The Philosophical Review,* 83:435-450.

Nida-Rümelin, Martine, 2006, "Dualist Emergentism", *Contemporary Controversies in the Philosophy of Mind*, Oxford: Blackwell.

Noordhof, Paul, 2003, "Not Old ... but not that New either: Explicability, Emergence and the Characterisation of Materialism". In: S. Walter & H. Heckman (eds.), *Physicalism and Mental Causation: The Metaphysics of Mind and Action*, Exeter: Imprint Academic, pp. 85-108.

Noordhof, Paul, 2010, "Emergent Causation and Property Causation". In: C. Macdonald & G. Macdonald (eds.), *Emergence in Mind*, Oxford, Oxford University Press, pp. 69-99.

O'Connor, Timothy, 1994, "Emergent Properties", *American Philosophical Quarterly,* 31:91-104.

O'Connor, Timothy, 2000, *Persons and Causes*, Oxford: Oxford University Press.

O'Connor, Timothy and Jacobs, Jonathan, D., 2003, "Emergent Individuals", *Philosophical Quarterly,* 53: 540-555.

O'Connor, Timothy, and Wong, Hong Yu, 2005, "The Metaphysics of Emergence", *Noûs,* 39:658-678.

Pepper, Stephen, 1926, "Emergence", *Journal of Philosophy*, 23:245-245,

Sartenaer, Olivier , 2013, "Neither Metaphysical Dichotomy nor Pure Identity. Clarifying the Emergentist Creed", *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences,* 44:365-373.

Schneider, Susan, 2012, "Why Property Dualists Must Reject Substance Physicalism", *Philosophical Studies,* 157:61-76.

Schneider, Susan, 2013, "Non-Reductive Physicalism and the Mind Problem", *Noûs,* 47:135–153.

Shoemaker, Sydney, 1980, "Causality and Properties". In: P. van Inwagen (ed.), *Time and Cause: Essays Presented to Richard Taylor*, Dordrecht: Reidel, pp. 109-135.

Shoemaker, Sydney, 1984, "Personal Identity: A Materialist's Account". In: Shoemaker and Swinburne (eds.), *Personal Identity*, Oxford: Blackwell.

Shoemaker, Sydney, 2003, *Identity, Cause, and Mind*, Oxford: Oxford University Press.

Shoemaker, Sydney, 2002, "Kim on Emergence", *Philosophical Studies,* 108: 53-63.

Shoemaker, Sydney, 2007, *Physical Realization,* Oxford: Oxford University Press.

Silberstein, Michael and McGeever, John, 1999, "The Search for Ontological Emergence", *Philosophical Quarterly,* 50:182-200.

Silberstein, Michael, 2006, "In Defence of Ontological Emergence and Mental Causation". In: Philip Clayton and Paul Sheldon, eds.) *The Re-Emergence of Emergence*, Oxford: Oxford University Press.

Skiles, Alexander, 2016, "Emergence Reinflated", *Philosophical Quarterly,* 66: 833-842.

Swoyer, Chris, 1982, "The Nature of Natural Laws", *Australasian Journal of Philosophy*, 60:203-223.

Taylor, Elanor, 2015a, "Collapsing Emergence", *Philosophical Quarterly,* 65:732-753.

Taylor, Elanor, 2015b, "An Explication of Emergence", *Philosophical Studies,* 172:653-669.

van Cleve, James, 1990, "Emergence Vs. Panpsychism: Magic or Mind Dust?", *Philosophical Perspectives,* 4:215-226.

van Gulick, Robert, 2001, "Reduction, Emergence and Other Recent Options on the Mind/Body Problem: A Philosophic Overview", *Synthese,* 8:1-34.

Wilson, Jessica, 1999, "How Superduper does a Physicalist Supervenience Need to Be?", *Philosophical Quarterly,* 49:33-52.

Wilson, Jessica, 2002, "Powers, Forces, and Superdupervenience", *Grazer Philosophische Studien*, 63:53–78.

Wilson, Jessica, 2005, "Supervenience-based Formulations of Physicalism", *Noûs,* 39:426-459.

Wilson, Jessica, 2007, "Newtonian Forces", *British Journal for the Philosophy of Science,* 58:173–205.

Wilson, Jessica, 2011, "Non-Reductive Realization and the Powers-Based Subset Strategy", *The Monist,* 94:121–154.

Wilson, Jessica, 2013a, "A Determinable-Based Account of Metaphysical Indeterminacy", *Inquiry,* 56:359-385.

Wilson, Jessica, 2013b, "Non-linearity and Metaphysical Emergence". In: *Metaphysics and Science*, Stephen Mumford and Matthew Tugby, eds. Oxford: Oxford University Press: 201-235.

Wilson, Jessica, 2014, "No Work for a Theory of Grounding", *Inquiry*, 57:535-579.

Wilson, Jessica, 2015, "Metaphysical Emergence: Weak and Strong". In: T. Bigaj and C. Wuthrich (eds.), *Metaphysics in Contemporary Physics: Poznan Studies in the Philosophy of the Sciences and the Humanities*, Leiden: Brill:345-402.

Wilson, Jessica, 2017, "Are There Indeterminate States of Affairs? Yes". In: E. Barnes, (ed.), *Current Controversies in Metaphysics*, London: Routledge:105-125.

Wilson, Jessica, forthcoming, *Metaphysical Emergence*. Oxford: Oxford University Press.

Wolff, Johanna, 2015, "Spin as a Determinable", *Topoi,* 34:379-386.

Yates, David, 2016, "Demystifying Emergence", *Ergo,* 3:809-841.