Author Meets Critics
Session on *Metaphysical Emergence*:
Replies

Jessica Wilson

University of Toronto

Introduction

I'd like to start by thanking Simone Gozzano, the patient editor and shepherd of this volume, Massimo Dell'Utri, the benevolent editor-in-chief of Argumenta, and Michele Paolini Paoletti, who initially suggested that an issue of Argumenta be devoted to *Metaphysical Emergence*. Simone, special thanks for your encouragement and your efforts; this is a great honour for me, and you have been a fantastic (and patient) collaborator, in print and in song. I'd also like to sincerely thank my commentators for their illuminating, fruitful, and provocative discussions of my book. The diversity of topics they have addressed, highlighting connections between metaphysical emergence and areas ranging from ontology to property theory to counterfactuals to mereology to quantum field theory to biochemistry and beyond, is truly striking, and a real testament to the wide-ranging import and applications of the notion of metaphysical emergence. Every contribution has given me substantive food for thought. For reasons of space I have focused my replies to each commentator on what I see as the most pressing of their remarks, but of course there is more to say, and I hope and anticipate that these conversations will continue on beyond this volume.

1. Replies to Bellazzi

Bellazzi offers a novel application of Weak emergence as the operative relation between the (broadly biological) function and (broadly chemical) structure of biochemical molecules, such as vitamin B12. As Bellazzi notes, biochemistry stands as a kind of 'hybrid domain' between chemistry and biology, with biochemical kinds understood as having micro-structural features of the sort characteristic of chemical kinds, and certain functions of the sort operative in biological systems. Given that the characterization of a biochemical kind incorporates both structural and functional features, the question arises of how these features stand to one another, as per what Bellazzi calls 'the relation problem'—a problem, and not just a question, reflecting a certain trickiness in identifying a relation capable of

accommodating certain constraints on the connection at issue. These constraints reflect that biochemical kinds are typically both multiply realizable (MR)—such that the same biochemical function can be realised by multiple microstructures—and multiply determinable (MD)—such that the same biochemical structure can realise multiple biochemical functions (see Slater 2009; Bartol 2016; Tahko 2020). These joint features of, or constraints on, the relation at issue are in place for Bellazzi's case study of vitamin B12, whose biochemical functions can be realised by any of four distinct vitamers, and whose biochemical structure(s) can play different roles in human physiology, including in DNA and RNA production, and in hematopoiesis/erythropoiesis.

Bellazzi convincingly argues, to my mind, that taking the relation between biochemical structures and functions to be one of Weak emergence provides an illuminating basis for accommodating MR and MD in the case of vitamin B12, and more generally in other cases of biochemical kinds. I will not repeat the details of her application here, but will rather highlight and discuss what I think are three important ramifications of Bellazzi's discussion for investigations in intra-level metaphysics. I close with some related questions about the specific application at issue.

The first moral of Bellazzi's application is that cases of emergence need not be associated with different 'levels.' Discussions of emergence tend to take for granted that this relation holds between goings-on (in the usual case: features) in different sciences. Hence in my book I focus on cases, e.g., where certain features of ordinary objects of the sort treated by Newtonian mechanics might emerge from features of quantum mechanical aggregates; or where certain thermodynamic properties of complex systems might emerge from properties of statistical mechanical aggregates; or where certain conscious mental states might emerge from neurological and ultimately lower-level physical states; and so on. In the case of biochemical kinds, however, and notwithstanding the connection to chemical and biological kinds and features, what appears to be at issue is the relation between seemingly distinct features of a kind treated by a single special science. The possibility of such intra-level emergence complexifies the structure of special scientific goings-on, both expanding the range of cases which might potentially involve metaphysical emergence, and also suggesting that we should be cautious about assuming that any case of metaphysical emergence is one generating a new 'level' of natural reality.[1] That said, the case of biochemical kinds and features also raises the questions of what relations (most saliently: identity or emergence?) hold between, first, the individual structural and functional components of biochemical kinds, and second, the features in the proximal sciences—i.e., between the structure of a biochemical kind and chemical structure, and the function of a biochemical kind and biological function. I'll return to this issue down the line.

A second moral of Bellazzi's application is that MD is an underappreciated resource so far as theorizing about inter-level metaphysics, and emergence in particular, is concerned. Discussions of emergence often advert to cases of multiple realizability (MR) of a given feature as providing some reason to think that the

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[1] A similar moral might be seen as read off of diachronic or 'transformational' conceptions of emergence (see, e.g., Humphreys 1997 and Guay and Sartenaer 2016) as involving fusion or some other interaction at a single level. Bellazzi's moral rather applies to cotemporal emergence of the sort traditionally associated with leveled structure.

feature cannot be treated in reductive (identity-based) terms, and is rather better treated as metaphysically emergent, one way or another. Hence in my book the potential bearing of multiple realizability on a given claim of metaphysical emergence (typically, of the Weak variety) comes up several times. As it happens, a theme of my discussions on this topic is that a feature's being multiply realizable isn't in itself sufficient to establish that the feature is Weakly emergent, at least antecedent to engaging with certain reductionist strategies for accommodating multiple realizability in identity-based terms—most commonly, by taking the lower-level feature to which the higher-level feature is supposed to be identical to be a disjunction of S's realizers; and I also argue that a feature's being multiply realizable isn't necessary for its being Weakly emergent. That said, it remains that the multiple realizability of a higher-level feature is the feature most commonly offered as indicative of a feature's being Weakly emergent. Now, as above biochemical kinds are MR, in that the same biochemical function can be realised by multiple microstructures; but they are also MD, in that a single biochemical structure may realize, or determine, multiple biochemical functions.

To see that MD is an underappreciated resource in theorizing about inter-level metaphysics, note that, notwithstanding that MR poses a prima facie difficulty for reductionism, there is in such cases at least an available candidate lower-level feature (namely, the feature consisting in the disjunction of the multiple lower-level realizers) for the reductionist to appeal to in conformity with their claim that every higher-level feature is in fact identical to some or other lower-level feature. But in cases of MD, it is less clear how an identity-based strategy is supposed to be implemented. Suppose that a single lower-level feature F is capable of determining multiple higher-level features (functional or otherwise) S_1, S_2, and S_3. Each determined feature is, according to the reductionist, identical to some or other lower-level feature, but which one? F can't be identical to just S_1, since in that case F's determination of S_2 and S_3 is unaccounted for. An alternative strategy would be to identify S_1 with some part or aspect of F, and similarly for S_2 and S_3; but even granting that such parts or aspects are available for the identification, as it stands it is unclear that these parts or aspects are properly seen as themselves being lower-level features, as the reductionist requires. Indeed, on some accounts of realization (per, e.g., Shoemaker 2000/2001 and Clapp 2001), token realized features are taken to be proper parts of their realizers. From this perspective, multiple determination poses even more of a challenge to reductionism than multiple realization.

A third moral of Bellazzi's application is that it encodes a distinctive response to the question of which subsets of powers of a given dependence base feature are, or can be, associated with a Weakly emergent feature. In my book, I largely leave it to the scientists to discover which entities and features, and associated powers, are plausibly hypothesized as making sense of natural reality, taking my goal to be that of saying how, given that such-and-such entities and features are supposed to have the key features of metaphysical emergence (as coupling dependence with ontological and causal autonomy), we can make sense of this supposition. I do offer one more specific answer to this question, in the context of discussing an implementation of Weak emergence involving an elimination in degrees of freedom; here the idea is that which degrees of freedom (and associated powers) are eliminated from the characterization of the higher-level feature will often reflect the holding of certain lower-level constraints. But attention to Weak emergence in biochemical kinds provides the basis for a new specific answer to the question

of which subsets of powers are associated with genuine features—namely, that this may be, as Bellazzi puts it, "a product of evolution", and more specifically (as per her forthcoming) that biochemical functions are "associated with a set of chemical powers to bring out a specific effect within biological processes" where these processes are a product of evolution, such that "the relevant chemical powers are indirectly evolutionary selected" (see also Santos et al. 2020). This 'evolutionary' route to identifying which subsets of powers of a given feature are associated with genuine, and moreover Weakly emergent features, is an important part of the background story about why natural reality has the structure it has, which promises to illuminate and apply to kinds and features in biological, ecological, and many other sciences. It also serves to show that there are apparently at least two quite distinct sources capable of generating Weakly emergent features: one broadly synchronic (as in the cotemporal imposition of constraints), and one broadly diachronic. As such, it is unclear whether we should expect a unified metaphysical explanation of which higher-level features come to exist, and why—an important result in its own right.

I want to turn now to raising some questions about Bellazzi's application, falling under the rubric of a single question—namely, how many (potentially instantiated) relations of Weak emergence might be associated with a given biochemical kind?

Let's assume that Bellazzi is right that biochemical functions Weakly emerge from biochemical structures. As above, in being MD, a given biochemical kind may have multiple biochemical functions, each of which would presumably be Weakly emergent from whatever biochemical structure is associated with the kind on a given occasion. So a biochemical kind is plausibly associated with as many Weak emergence relations as the kind has biochemical functions. But now recall that, in being MR, a given biochemical kind may have multiple biochemical structures.[2] And for each such biochemical structure, the question arises of whether it is identical to, or rather (presumably, Weakly) emergent from, a chemical structure. Perhaps each biochemical structure is just identical to some chemical structure, as is suggested by the characterization of biochemistry as "the science that considers the behaviour and effects of chemical processes in biological systems" (Bellazzi, this volume, per Santos et al. 2020). But perhaps there are cases to be made that some or all biochemical structures have only a proper subset of the token powers of associated chemical structures. In that case, a biochemical kind would be associated with as many Weak emergence relations as the kind has distinct realizers. Finally, just as there is a question of what relation holds between chemical and biological structures, there is a question of what relation holds between biochemical and biological functions. Might the latter relation(s) also be ones of Weak emergence? If so, a biochemical kind would be associated with as many Weak emergence relations as the kind has biochemical functions—now running not (as in Bellazzi's case) from biochemical structure to biochemical function, but rather running from biochemical function to biological function.

I offer these questions as further food for theorizing for Bellazzi and others working on the metaphysics of biochemistry. In any case, I'm well convinced that attention to the distinctive characteristics of biochemical kinds points the way towards several new avenues of investigation in the metaphysics of emergence.

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[2] I assume that each such structure can serve as a dependence base for any (i.e., all) of the biochemical kind's biochemical functions.

2. Replies to Bennett

In my book, I motivate the powers-based schemas for Weak and Strong metaphysical emergence by attention to the problem of mental/higher-level causation, pressed by Kim (1989 and elsewhere); my basic line is that the two schemas encode the strategies operative in the only responses to Kim which accommodate metaphysical emergence, understood as coupling cotemporal material dependence and (ontological and causal) autonomy. I motivate the schema for Weak emergence, more specifically, by attention to non-reductive physicalist (NRPist) responses to Kim's problematic, which posit diverse relations (functional realization, compositional mechanism, the determinable-determinate relation, and so on) advanced as making sense of how cotemporally dependent higher-level features may be distinct and distinctively efficacious as compared to their physical base features, in a way not involving causal overdetermination of the 'double-rock-throw' variety that makes little sense for the cases at issue. I argue that "a deeper unity of strategy" underlies the seemingly diverse NRPist accounts—namely, that the posited relations[3] each guarantee that, on any given occasion, the higher-level feature has only a proper subset of the token powers of the physical feature upon which it cotemporally materially depends; and I argue that the holding of the Proper Subset of Powers condition, along with the cotemporal material dependence condition, captures what is core and crucial to metaphysical emergence of a physically acceptable variety.

In her contribution, Bennett offers three challenges to this motivation for my account of Weak emergence. The first is that there is an alternative NRPist response to Kim's problematic—Bennett's 'Counterfactual Strategy'—which also encodes "a deeper unity of strategy", but which does not involve any reference to the Proper Subset of Powers Condition. The second is that the Proper Subset Strategy itself does not establish the efficacy of the mental (or Weak emergents more generally). And the third is that the means by which Weak emergent efficacy avoids overdetermination is not as ontologically neutral as I have made it out to be. These challenges are well worth considering; in what follows, I present and respond to each in turn.

2.1 Challenge 1: The Counterfactual Strategy

As noted, I see the deeper unity of strategy underlying diverse NRPist accounts posits as reflecting that their chosen relations guarantee satisfaction of the Proper Subset of Powers condition at the heart of my schema for Weak emergence; but drawing on her 2003 and 2008, Bennett suggests that the underlying unity reflects that the relations posited by NRPists allow implementation of what she calls the 'Counterfactual Strategy' in response to Kim's concerns about overdetermination:

> Talk of overlapping sets of causal powers is not the only way to explain how various intimate relations between the causes defuse the threat of overdetermination. In a (2003) paper, I offered a different explanation. I provided a necessary condition on overdetermination (genuine, 'double-rock' overdetermination), and argued that it is

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[3] Not including supervenience or other mere modal correlations, which for various reasons are too weak for physicalist purposes; see Wilson 2005 and McLaughlin and Bennett 2018.

not met by pairs of causes related in any of the ways [Weak emergentists/NRPists] think that mental and physical phenomena are.

The necessary condition is simply that two causes overdetermine an effect only if had either happened without the other, the effect would still have occurred. That is, causes c_1 and c_2 overdetermine e only if both of the following counterfactuals are nonvacuously true:

$(c_1 \wedge \neg c_2) \rightarrow e$

$(c_2 \wedge \neg c_1) \rightarrow e$

This is a very intuitive test for overdetermination. […] if the test is legitimate, the [Weak emergentist/NRPist] is again in good shape. At least one of these counterfactuals will be vacuous or false when (2003) and only when (2008) the mental and physical causes stand in one of the […] favored relations. […] the basic idea is that on any such relation, the physical base necessitates the weakly emergent mental phenomena, rendering one of the counterfactuals vacuous. (241)

As Bennett's past work makes clear, the necessitation at issue here is metaphysical, such that in every possible world where the physical base feature is instanced, so will be the higher-level mental feature. As such, if c_1 is a mental feature M, and c_2 the mental feature's physical base P, then the counterfactual '$(P \wedge \neg M) \rightarrow e$' will be vacuously true, and the necessary condition for overdetermination will fail to be met.

Bennett offers the Counterfactual Strategy as a kind of 'minimalist' response to Kim's problematic, in the sense that it provides a basis for denying one of the premises in Kim's argument—namely, on Bennett's reconstruction, the premise ('Exclusion') according to which all events that have multiple sufficient causes (that are not themselves causally related) are overdetermined. The Counterfactual Strategy is minimalist in being silent on further details about how, exactly, a higher-level feature might be efficacious in such a way as to avoid overdetermination. That said, as above Bennett does suppose that the Counterfactual Strategy unifies NRPist approaches, and relatedly (as is developed in her 2008) is not available to dualists, including Strong emergentists. In what follows I'll offer three reasons for thinking that the Counterfactual Strategy is subject to problems rendering it unsuccessful even with respect to these minimalist aims. As I'll also observe, the Proper Subset Strategy does not incur these problems, and so is correspondingly advantageous.

2.1.1 Response 1: The Illegitimacy of the Test

Is Bennett's test 'legitimate,' in being a necessary condition on overdetermination, such that failure of one or other counterfactual to be non-vacuously true will get one off the overdetermination hook? No, for it is easy to construct cases of clear overdetermination, where the overdetermining phenomena are nonetheless sensitive to whether the other occurs. Indeed, the whole point of firing squads is to ensure that everyone pulls the trigger, so that no individual is to blame. We can similarly set things up so that Billy and Suzy make a pact that they will each throw the ball at the window only if the other does, so that in the closest worlds where either doesn't throw, neither does the other.

It is an advantage of the Proper Subset Strategy that, unlike the Counterfactual Strategy, it doesn't rely on a condition on overdetermination that is subject to clear counterexample.

2.1.2 Response 2: The Controversy and Context-sensitivity of Counterfactual Assessment

Counterfactual deliberation and assessment are subject to controversy and context-sensitivity. The controversy at issue pertains not so much to the general account of counterfactual truth—most accept some kind of similarity-based account, where a counterfactual is true just in case in the closest world(s) where the antecedent is true, the consequent is true—but rather to the question of how worlds are to be ordered with respect to similarity, given that (as Fine, 1975, nicely established) overall similarity won't do. At present there is no agreement either on more specific criteria of similarity or their ranking. Relatedly, similarity judgements are highly context-sensitive. Bennett briefly registers this in discussing a move according to which (relative to some contexts) events are highly fragile—so fragile that in cases of overdetermination, it turns out to be false that had one but not the other event occurred, then the (same type of) effect would still have been produced.[4] But the more general point is that, given the context-dependence of similarity, whether the counterfactual conditions on overdetermination are or are not met is going to depend on context. Relative to one context, perhaps, there's no overdetermination; relative to another, there is. In that case, Bennett's condition does not provide a clear basis for a response to Kim, but rather pushes the bump in the rug to the question of which contexts are most crucial so far as questions of overdetermination are concerned.

It is an advantage of the Proper Subset Strategy that, unlike the Counterfactual Strategy, it (and the associated response to Kim) isn't subject to the controversy and context-dependence of counterfactuals.

2.1.3 Response 3: failing to distinguish Weak and Strong emergentist responses to Kim

As above, Bennett intends that the Counterfactual Strategy unify Weak emergentist/NRPist responses to Kim's problematic, and distinguish these from anti-physicalist dualist, including Strong emergentist, responses. But as I'll now argue, the Weak and Strong emergentist can implement the Counterfactual Strategy in exactly the same way. Bennett can distinguish these responses, but at the price of taking on board certain controversial metaphysical commitments—commitments not needed to implement the Proper Subset Strategy.

To start, consider the overdetermination counterfactuals for a mental feature M that is supposed to be Weakly emergent. The counterfactual '$(M \land \neg P) \to e$' will likely be non-vacuously true, given the usual assumption that mental states may have diverse physical bases (in a physicalist context: are 'multiply realizable'); for then the nearest antecedent worlds will likely be ones where M has a slightly different physical base (realizer), and M causes e. However (per Bennett's characterization of the NRPist's response to Kim), '$(P \land \neg M) \to e$' will be only vacuously true, given that P metaphysically necessitates M.

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[4] Note that this amounts to another 'Counterfactual Strategy' that the NRPist could avail themselves of in response to Kim. Bennett suggests that those endorsing fragile events take the effect to be jointly caused by higher-level and base features, but that diagnosis of the effect's fragility is optional—the fragile event NRPist can just adopt Bennett's minimalist stance and resist calls to provide details about how, exactly, higher-level features enter into causing effects.

Now consider the overdetermination conditionals for a mental feature M that is supposed to be Strongly emergent. The counterfactual '$(M \wedge \neg P) \rightarrow e$' will likely be non-vacuously true, given the usual assumption that mental states may have diverse physical bases (in anti-physicalist context: are 'multiply determined'); for then the nearest antecedent worlds will likely be ones where M has a slightly different physical base, and M causes e. What about '$(P \wedge \neg M) \rightarrow e$?' In her 2008, Bennett argues that the NRPist treatment of this counterfactual "is not available to the dualist": "the dualist cannot say that [this counterfactual] is either false or vacuous [...] For the dualist, cases of mental causation do meet the necessary condition on overdetermination". Most relevant here is Bennett's reason for thinking that the dualist (Strong emergentist) cannot claim that the relevant counterfactual is vacuous:

> It is clear that only the physicalist can say that ['$(M \wedge \neg P) \rightarrow e$'] ever comes out vacuous. The dualist cannot, because she does not think that there are any physical events or properties that metaphysically necessitate mental ones. She precisely thinks that there are—at best!—contingent psychophysical laws that link the two. So the dualist denies that there is any legitimate substitute for [P] that would make the antecedent metaphysically impossible. She at most thinks that there are choices of [P] that would make the antecedent nomologically impossible. So the dualist cannot claim that any instance of [the counterfactual] is vacuous. (2008: 290)

This line of thought builds in a controversial metaphysical commitment, however—namely, that Strong emergents are nomologically but not metaphysically necessitated by their physical bases. As I discuss in my (2005), however, there are several views on which Strong emergents are metaphysically necessitated by their physical bases, including a modally consistent Malebranchean occasionalism, a view of properties as essentially constituted by all of the laws into which they enter, and a view of fundamental interactions as holistically unified. Moreover, I argue, the latter two views enjoy considerable empirical support, by contrast with Humean 'anything goes' versions of contingentism which greatly depart from scientific theorizing and practice. Whether or not one accepts any of these views, the fact remains that Bennett's Counterfactual strategy does not itself distinguish between the Weak and Strong emergentist strategies, independent of further controversial assumptions about the modal strength of the connections at issue.

Indeed, upon closer examination even the supposition that the NRPist's favoured relations are such that a physical base metaphysically necessitates a Weak emergent can be denied. Consider functional realization, according to which, e.g., mental feature M is associated with a distinctive causal or functional role, which on a given occasion is played by some lower-level physical feature P. Need P metaphysically necessitate M? Not on causal contingentist views, on which properties and powers may come apart; for on such views there is no guarantee that P, instanced in worlds with different laws of nature, will have the powers requisite unto playing M's causal role. For such a contingentist functionalist NRPist, it might well be that both of the counterfactuals in the Counterfactual Strategy turn out to be non-vacuously true. Correspondingly, the success of the Counterfactual Strategy requires a further metaphysical commitment—namely, the rejection of causal contingentism.

By way of contrast, the Proper Subset Strategy clearly distinguishes between the Weak and Strong emergentist responses to Kim, in a way that is moreover

neutral both on whether either relation holds with metaphysical necessity (requiring only, as per the cotemporal material dependence condition which NRPists and Strong emergentists agree is in place, that emergents supervene with at least nomological necessity on physical goings-on) and on whether causal contingentism is true.

2.2 Challenge 2: No Explanatory Advantage

Putting aside the previous concerns and granting that Bennett's Counterfactual Strategy suffices to undercut the Exclusion premise of Kim's argument, one might wonder whether the Proper Subset Strategy is more explanatory than the Counterfactual Strategy, in going beyond a minimalist response to establish that mental goings-on, in particular, are efficacious. Bennett registers, however, that she is skeptical of this:

> [Wilson's strategy] could solve the exclusion problem and secure the causal efficacy of the mental. But I am still skeptical; I do not think the strategy actually does secure that. All the work is done by Wilson's claim that weakly emergent entities have a nonempty proper subset of the causal powers of their bases. This is the only reason we are guaranteed that weakly emergent entities have causal powers. But Wilson never argues that any particular thing or kind of thing has a non-empty set of causal powers; that is just part of her definition of weak emergence. So those who are inclined to be worried about the causal efficacy of the kinds of phenomena she takes to be weakly emergent—like the mental—will simply deny that they are weakly emergent in her sense. (244)

I agree with Bennett that the Proper Subset Strategy qua response to Kim doesn't itself establish that the mental or any other phenomena is efficacious. The Strategy qua response is at that point in-principle, specifying what it would take for some phenomenon to be Weakly emergent in a way in line with NRPist intentions and accounts. Similarly for the New Power Strategy at the heart of the schema for Strong emergence.

Arguments that mental or other phenomena actually have "a non-empty set of causal powers" come later. Hence after arguing for the in-principle viability of (my conception of) Weak emergence (Ch. 3), I argue that there are good cases to be made that complex systems (Ch. 5), ordinary objects (Ch. 6), qualitative mental states (Ch. 7), and (compatibilist) events of free choosing (Ch. 8) satisfy the conditions in the schema for Weak emergence. I motivate the satisfaction of the Proper Subset of Powers condition by attention to a variety of (empirical, philosophical, introspective, etc.) considerations. In brief (see the chapters for details): for complex systems, satisfaction of the condition mainly hinges on the applicability of the renormalization group method and associated elimination of microphysical degrees of freedom (DOF), coupled with my DOF-based account of Weak emergence; for ordinary objects, satisfaction hinges, alternatively, on the elimination of quantum DOF, on sortal practices of individuation, and on ordinary objects' having metaphysically indeterminate boundaries, understood as per my determinable-based account of metaphysical indeterminacy and coupled with a determinable-based account of Weak emergence; for conscious (qualitative) mental states, satisfaction mainly hinges on perceptions' being determinable, coupled with a determinable-based account of Weak emergence; and for (non-libertarian) free will, satisfaction hinges on an understanding of 'relevant antecedent'

approaches to compatibilist free will according to which the powers of the complex event comprising the relevant antecedents are a proper subset of those associated with the complex event comprising the complete antecedents.

Does the fact that qua response to Kim, the Proper Subset Strategy doesn't itself establish that the mental is actually efficacious mean that the Strategy doesn't have any explanatory advantage over the Counterfactual Strategy? I'm inclined to deny this, for two reasons. First, unlike the Counterfactual Strategy, the Proper Subset Strategy provides an explanatory basis for not just the efficacy, but moreover the distinctive efficacy, of Weak emergents—a distinctive efficacy which tracks difference-making considerations (if my thirst had been differently realized, I would still have reached for the Fresca) associated with comparatively abstract systems of laws or levels of causal grain. Independently of further investigations into which phenomena are actually Weakly emergent, this conception of distinctive efficacy provides the basis for a more compelling NRPist response to Kim than does the Counterfactual Strategy; for it undercuts Kim's incorrect supposition that the distinctive efficacy of a higher-level feature can only lie in the having of a novel power, contra Physical Causal Closure, hence contra Physicalism. Second, unlike the Counterfactual Strategy, the Proper Subset Strategy provides a blueprint for establishing that a given phenomenon is Weakly emergent, and so is not just efficacious but distinctively so—a blueprint that is, as I argue, often realized.

2.3 Challenge 3: Undue Ontological Commitment

Bennett's third challenge is that on the face of it, implementing the Proper Subset Strategy for avoiding overdetermination requires "ontological commitment to trackable, countable causal powers".

> [T]he success of the Proper Subset Strategy entirely depends on the idea that the causal powers of the emergent phenomena are numerically identical to the causal powers of the base. And this in turn requires that token causal powers are the sort of thing that can not only be counted but also individuated. Indeed, it is very, very hard not to imagine them as pebbles in a bucket—and Wilson's diagrams on page 70 suggest that she cannot resist this picture either. But this is a serious and rather discombobulating ontological commitment. I will not argue here that causal powers are not like that, but I suspect others will share my reticence. Even Wilson takes pains to insist that her causal powers are nothing dubious or creepy:

>> Talk of powers is simply shorthand for talk of what causal contributions possession of a given feature makes […] to an entity's bringing about an effect, when in certain circumstances… no controversial theses pertaining to the nature of powers, causation, properties, or laws are here presupposed. (32–33; also 45)

> But the question is, can she really make good on this neutrality? More precisely, can she assuage my ontological qualms while retaining the nice claim that strictly speaking, there is really only one cause of an effect caused both by a weakly emergent phenomenon and its base? That is the challenge I lay before her. […] My real point here is that one cannot have the Proper Subset Strategy on the cheap; the cost-benefit analysis must be made. We can shoulder the ontological commitment to trackable, countable causal powers and accept the benefits, or we can be squeamish and reject the whole picture. (245–44)

I think this is a fair question, but by way of convincing the skeptic I'm not sure what to say beyond what I've already said. As above, and notwithstanding the convenient schematic representation of powers as 'pebbles in a bucket,' I am explicit about the operative notion of 'power' as simply tracking what (actual or potential) causal contributions the having of a given feature makes when instanced in certain circumstances. As I note by way of proof of metaphysical neutrality, even a contingentist categoricalist Humean can make sense of powers in this sense:

> [E]ven a contingentist categoricalist Humean—someone who thinks that causation is a matter of regularities, such that features have their powers contingently, and that all features are ultimately categorical—can accept powers and the associated notion of causation in the neutral sense(s) here: for such a Humean, to say that an (ultimately categorical) feature has a certain power would be to say that, were a token of the feature to occur in certain circumstances, a certain (contingent) regularity would be instanced. Contemporary Humeans implement more sophisticated variations on this theme; but the point remains that no 'heavyweight' notion of powers or causation need be presupposed in what follows. (33)

So far, so metaphysically neutral. But is it really the case that, as I claim in discussing the schemas, "effectively all participants to the debate can make sense of such identity (non-identity) claims as applied to token (actual or potential) causal contributions (token powers)" (45)? If one has a conception of dispositions or powers as ontological existents, then presumably there is no in-principle difficulty with making sense of these being token identical, in any given case. But as I note by way of proof of metaphysical neutrality, even a contingentist categoricalist Humean can make sense of such identification:

> For example, suppose a contingentist categoricalist Humean wants to take a physicalist approach to the problem of higher-level causation, and so aims (as I will expand on §2.3) to identify every token power of a token higher-level feature with a token power of its lower-level base feature. As previously discussed, such a Humean understands powers in terms of actual or potential instances of a (contingent) regularity. Where the aim is to avoid overdetermination, the Humean may suppose, to start, that the (relevant instances of the) regularities overlap, both with respect to the (single) effect, and with respect to the (single) circumstances in which the two token features occur. If the Humean aims to be a reductive physicalist, they may suppose that such overlap motivates identifying the token features at issue, and hence the associated powers. If the Humean aims to be a nonreductive physicalist, they can reject this identification of features, on difference-making or other grounds of the sort to be discussed §2.3. Such a Humean will suppose that attention to broader patterns of regularities can provide a basis for identifying token powers of token features, even when the token features are not themselves identical. Whether reductive or nonreductive, the contingentist categoricalist Humean can make sense of the claim that some, all, or none of the token powers of token features are identical. As I observed in my (2015: 35), this case is like the case of New York: if we can make it (out) here, we can make it (out) anywhere. (45–6, note 15).

That said, it is worth clarifying that it isn't any part of my view that "there is really only one cause of an effect caused both by a weakly emergent phenomenon and its base"—i.e., the causal power that the mental feature shares with its physical

base. If that were part of my view, I can see why one might be skeptical about the supposed metaphysical neutrality of powers: plausibly, a cause must be some kind of real existent! But on my view it is features (properties, events, etc.) or associated objects which are causes; and talk of powers is (again) just talk of what contribution the having of a given feature can make to the production of certain effects when the feature is instanced in certain circumstances. As such, in any given case of Weak emergence there are indeed two causes on the scene: the two features which share the token power—that is, which are such that their contributions to producing the effect in the circumstances overlap. Relatedly, in her note 6, Bennett says that "given the Proper Subset of Powers strategy, [Wilson] should not think that the effects of mental causes are overdetermined *at all*. For an effect to be overdetermined, it must have at least two distinct causes. But the only sense in which Wilson's [Weak emergentist/NRPist] thinks there are two distinct causes is that there are two distinct phenomena that literally share the efficacious part". Some (e.g., Shoemaker) might want to think of powers or associated potential contributions to the production of effects in mereological terms (as "efficacious parts") but even for such a person, it is the features having the power, not the power itself, that cause the effect. In any case, it's no part of my view that the real 'cause' of a Weak emergent effect is a shared power—so perhaps this clarification will assuage at least some of Bennett's skepticism.

3. Replies to Calosi

In his contribution, Calosi advances a novel mereology—a broadly formal theory of parts and wholes—which aims to (a) accommodate the possibility of metaphysical emergence, without (b) introducing non-mereological structure (as on variations on the theme of hylomorphism; see Koslicki 2008, Fine 2010, and Sattig 2015) or multiplying notions of parthood (as per Cameron 2007 and Canavotto and Giordani 2020). On Calosi's view, a single notion of sum provides the means of accommodating both reducible and irreducible—i.e., emergent—wholes.

The basis of Calosi's mereological framework (following Calosi and Giordani in progress*a* and in progress*b*) is a new conception of sum:

$Sum(xx, y) \equiv xx < y \wedge$
$\forall x (\neg x \circ xx \rightarrow \neg x \circ y) \wedge$
$\forall x (xx < x \rightarrow y < x)$

Sum is distinct from, and moreover stronger than, existing notions in the literature (see Cotnoir and Varzi 2021), in entailing each other notion while not being entailed by any. The associated mereology assumes an unrestricted composition principle (whereby any plurality of objects composes a Sum), and various axioms governing parthood, including antisymmetry, transitivity, and quasi-supplementation. System in hand, Calosi defines the notions of a 'simple' (having no object as a proper part) and a 'composite,' as the negation of 'simple'; and by appeal to the unrestricted composition principle defines a total function assigning to each object the 'matter' of the object, where the matter of a simple object is the object itself, and the matter of a composite object is the Sum of its components. Calosi is thereby able to distinguish between what he calls a 'Reducible Whole'—a whole that is identical to its matter—and an 'Irreducible Whole'—a whole that is not so identical, which distinction he takes to intuitively correspond to the distinction beween a whole's being 'nothing over and above' its parts (his illustrative cases

being a heap of sand and a lump of clay) vs. 'something over and above' its parts (his illustrative cases being tables, trees, organisms, and statues). And Calosi observes that, given all this, it follows that any simple object is Reducible, and any Irreducible object is composite; but the converse entailments do not hold (some Reducible objects may not be simple; some composite objects may not be Irreducible). Now for the connection to emergence:

> It should be clear why the present proposal has a chance to provide a mereology for emergent wholes: it allows for irreducible wholes that are something over and above their proper parts, i.e., their matter. Indeed, I suggest that, faced with cases of emergent wholes (E) we should endorse the following conditional:
>
> if emergent(x) then Irreducible(x)
>
> That is, Irreducibility as defined above is a necessary condition for emergence. (250–51)

Given that (as above) any Irreducible object is composite, it moreover follows on Calosi's system that

if emergent(x) then composite(x)

That is, being composite is a necessary condition for emergence. Calosi is officially neutral on whether being Irreducible (hence being composite) is sufficient for emergence, since he allows that there might be other 'grounds' for irreducibility. So as I understand Calosi's suggestion, if we have reason to think that some goings-on are emergent, then Calosi's mereology can accommodate them, at least to the extent of satisfying certain key necessary conditions. In this latter respect, Calosi takes his mereology to do better than certain alternative mereologies—most saliently, reductivist conceptions on which composition is identity, and eliminativist conceptions on which there are no composed entities (as per mereological nihilism), which (for reasons that I'll return to below) have been taken to be incompatible with the possibility of emergence, at least of a Strong variety.

By way of further motivating his proposed connection between mereology and emergence, Calosi argues that his account provides a basis for accommodating certain features of emergence as highlighted in my book. First, that emergents depend on yet are distinct from their bases is accommodated in that an Irreducible whole depends on its parts (its 'matter') in that "were we to annihilate its matter, it is unclear that anything would remain of the whole"; yet an Irreducible whole is by definition distinct from its matter. Second, that emergents are typically compositionally flexible is accommodated, at least potentially, in that Irreducible wholes are not identical to compositionally inflexible Sums (Reducible wholes). Third, that emergent entities typically fall under sortals (e.g., 'being a table' or 'being a statue') is accommodated by taking a given sortal to refer to an Irreducible whole as opposed to its Sum (matter). Correspondingly, one need not resort to a non-extensional notion of sum (as on Simons 1987) in order to make sense of, e.g., the applicability of the sortal 'statue' to a lump of clay. Finally, Calosi suggests, his mereological system provides a basis for the leveled structure associated with the special sciences, with special science entities at a level being Irreducible wholes that at each level emerge from sums of Reducible or Irreducible wholes, characteristic of the next level down.

Calosi and Giordani's distinctive mereological framework strikes me as in many ways intuitively plausible and theoretically powerful; in particular, it is a

significant accomplishment to identify and systematize a conception of Sum that unifies and asymmetrically entails existing conceptions. Moreover, I am inclined to agree with Calosi that his application of this framework can be seen as providing a basis for a common characterization of emergent entities as wholes that in some sense exist 'over and above' the mere sum of their parts, which in turn might be seen as confirming an also-common supposition that the notions of emergence and of mereology are deeply connected, such that (at a minimum) emergent entities are necessarily composite, and emergent features are necessarily features of composites.

Even so, in what follows I want to cast a somewhat skeptical eye on the extent to which Calosi's mereology can provide a basis for emergence, and on the more general supposition that emergence and mereology are necessarily connected. I'll start by arguing that while Calosi's application of his mereological framework plausibly provides a basis for *a* conception of emergence, this conception is different both from that which he seemed to have in mind in offering his illustrative cases of Reducible and Irreducible wholes, and from that which I aim to characterize in my book; and I'll draw out certain implications of this result for his project. I'll then highlight some considerations which indicate that the connection between emergence and mereology is not as deep (or necessary) as has sometimes been assumed.

To begin: recall that Calosi characterizes Reducible wholes as those which are (as he puts it) intuitively 'nothing over and above' their parts, with his examples being of unstructured entities or aggregates such as heaps and lumps of clay, and Irreducible wholes as those which are intuitively 'something over and above' their parts, with his examples being those of structured entities such as tables, trees, organisms, and statues; and he wants to make use of the distinction between Irreducible and Reducible wholes to at least make room for entities to be emergent, or not.[5] Now, an initial problem here, which poses a problem for identifying a purportedly Reducible heap or lump of clay with its 'matter,' is that heaps and lumps aren't identical to the sum of their scattered parts, in which case Calosi's mereology deems heaps and lumps Irreducible as opposed to Reducible wholes, and so doesn't distinguish his illustrative paradigm cases (which in turn were supposed to be candidates for non-emergent vs. emergent wholes). In any case, at best the Reducible/Irreducible distinction operative here is apt for distinguishing completely unstructured objects—mere collections, as fusions—from any at-all-structured objects.

Now, the distinction between structured and (completely) unstructured entities is no doubt important. It has played an important role, in particular, in discussions of the metaphysics of ordinary objects, as entities which are structured as opposed to unstructured collections of parts, as in Koslicki's (2008) motivating case of a (structured) motorcycle and an (unstructured) heap of motorcycle parts. But this distinction has not played an important role in debates about whether seemingly higher-level (ordinary, special scientific) goings-on are reducible or rather emergent.

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[5] Calosi does not specify whether the emergence at issue is to be understood in Weak or Strong terms. In discussing the application of his framework to accommodating leveled structure of the sciences he seems to have Weak emergence in mind; but on the other hand concerns about whether emergence is compatible with reductive or eliminativist conceptions of composition typically suppose that the emergence at issue is Strong. In any case, which form of emergence is at issue won't matter for my present point.

To see why this is so, note that reductive physicalists, who think that any given special science entity or feature is type identical to some or other (perhaps logically or otherwise complex) lower-level physical feature, *take for granted* that the entities to which special science entities are identical are structurally complex (which is not to say that they are committed to composites as distinct from pluralities, about which more anon). It's no part of the reductive physicalist's view to maintain that tables, trees, organisms, or statues are identical to unstructured entities or aggregates. Rather, to take a toy example, a reductive physicalist might identify a certain table with a relational aggregate of atoms standing in atomic relations (or a disjunction of such aggregates, to allow for the table to persist through some change), and so on.[6] So the distinction between something that is in some sense just an unstructured sum of parts and something that is rather in some sense a structured aggregate isn't, at least in the usual cases, what is at issue in the physicalism debates, or in the related debates over whether or not there are multiple 'levels' of natural reality. And nor is it what is at issue in my attempts (in my book and elsewhere) to characterize metaphysical emergence in a way making sense of the appearances of higher-level reality. Rather, what is at issue in these contexts is the question of whether, *in addition* to whatever massively complex, typically highly structured, lower-level physical goings-on there might be, there are moreover any goings-on which are properly seen as (cotemporally materially) dependent on and (ontologically and causally) autonomous from the (massively complex, typically highly structured) lower-level physical goings-on that emergentists and non-emergentists alike agree exist.

Again, this is not to deny that there might be a different, weaker conception of metaphysical emergence that the broad distinction between unstructured sums and structured wholes might latch onto. It would serve, for example, to characterize an extreme form of reductive physicalist—call them 'the reductive pluralist'—who maintains that every apparently structured entity is really identical to some unstructured lower-level physical entity (or logical construction thereof). My point here is just that Calosi's conception of emergence as 'mirrored in' the distinction between (unstructured) Reducible and (structured) Irreducible entities is not obviously suited to accommodating metaphysical emergence of the sort at issue in debates over leveled structure, and which I aim to characterize.

The previous result has certain implications for Calosi's advertised characterization of his mereology as able to accommodate emergence without requiring additional (e.g., hylomorphic) non-mereological resources or multiplying notions of parthood. For insofar as the conception of emergence for which Calosi's system provides a basis is too weak to distinguish between non-emergent structured entities (of the sort the reductive physicalist accepts) and emergent structured entities (of the sort that Weak and Strong emergentists accept), it remains open that properly accommodating metaphysical emergence might require such additional resources or notions of parthood, after all. That said, it remains unclear to me whether we should be asking our mereological systems to do this work. So far as

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[6] Nor is the reductive physicalist's characteristic rejection of there being multiple 'levels' of natural reality (as per, e.g., Heil 2003) based in the supposition that there are no structured wholes. Rather, reductionists as well as emergentists will accept that there are 'levels' of the sort that Calosi offers as 'mirroring' the Weak emergentist conception of multiple levels—though they will then deny that these mereologically-generated levels are tracking what is at issue between them.

I can tell, the conditions I provided on metaphysical emergence in my book don't rely, even indirectly, on any mereological notions.[7]

This brings me to my next topic, which pertains to the question of whether the notions of emergence and mereology are necessarily connected, as in Calosi's claims that if an object is emergent, then it is Irreducible, and (coupled with his supposition that if an object is Irreducible, then it is composite) that if an object is emergent, then it is composite.

Now, it is indeed sometimes claimed that composition is a necessary condition on emergence. For example, Baron (2019) says, "[m]ereological composition is usually thought to be at least a necessary condition on dependence: the emergent entity is composed of the entities from which it emerges" (2210). Calosi (2016a) agrees, saying that "An emergent property is a property which is exemplified by a composite object" (441).

As I see it, however, there are two good reasons to deny that composition is a necessary condition on emergence. First, even if it is granted that an emergent entity must cotemporally depend on a composite entity, as has often (though not universally; see below) been assumed for cases of both Weak and Strong emergence, the bearer of the emergent feature might not be composite. Consider the case of persons and their bodies. It is commonly maintained that persons are emergent, either Weakly or Strongly, in having Weakly or Strongly emergent mental states. But this much doesn't require that persons *themselves* be composite: perhaps they cotemporally depend on composites (bodies, or lower-level aggregates) without themselves having parts.[8] So there can be uncomposed emergent entities, and emergent features (e.g., mental states of non-composite persons) not exemplified by composites. Second, it's unclear that an emergent entity or feature has even to cotemporally depend on anything composite. One sort of possibility here involves a simple entity emerging, Weakly or Strongly, from another simple entity, when the latter is in appropriate circumstances. In the Weak case: perhaps the emergent is a determinable of a more determinate simple entity.[9] Perhaps that's a non-standard case, but it seems coherent to me. Another and quite standard option would involve the emergent entity (feature) cotemporally depending on a plurality (feature of the plurality). In my book I register this possibility, and more generally make room for the base-level goings-on to be pluralities or features of such pluralities (as opposed to, e.g., relational aggregates and features of such aggregates). In any of these cases, there might be emergence of either Weak or Strong varieties in the absence of composition as involving anything like a 'whole.'

[7] Of course, in some cases a given implementation of either Weak or Strong emergence might well involve the supposition that the emergent entities (features) at issue are composed (are features of composed entities); my own degrees-of-freedom-based account of Weak emergence is a case-in-point. But even here, the appeal to mereology is mainly serving as a way of ensuring that the condition on cotemporal metaphysical dependence (encoding the supposition of substance monism generally operative in accounts of emergence), is met; it is not itself serving as the basis for emergent autonomy.
[8] Would persons then not be 'concrete?' I don't see why not, given that they exist in spacetime (see Armstrong 1978).
[9] Note that the determinable-determinate relation is typically not cashed in mereological or related (e.g., conjunctive) terms. Most saliently, to be determinate is not to have a determinable as a proper part: determinates (unlike wholes) do not satisfy anything corresponding to supplementation.

The previous considerations undercut Calosi's necessary conditions on emergence, and more generally suggest that the connection between emergence and mereology might not be as intimate as Calosi and some others have taken it to be.

But what about arguments aiming to show that (the possibility of) emergence is incompatible with reductionist approaches to composition such as composition as identity (CAI), according to which mereological fusions are just identical to the plurality of their parts (see McDaniel 2008, Schaffer 2010, Calosi 2016a and 2016b)? Don't such arguments show that there is a deep connection between emergence and mereology, after all? Though I cannot address all such arguments here, I believe that their conclusions can be resisted, for reasons set out in Bohn 2009 (see also Cornell 2017 for a similar strategy). Bohn focuses his attention on the argument in McDaniel 2008, which Bohn schematically characterizes as follows:

1. Emergent properties are possible
2. If CAI is true, emergent properties are impossible
3. CAI is false

Here the focus is more specifically on Strongly emergent properties. Granting that Strongly emergent properties are possible (a claim with which I agree), why think that such properties would be incompatible with CAI? McDaniel's line of thought is that such an assumption leads to a violation of Leibniz's Law, according to which identicals are indiscernible. To start, let some xx be a plurality of two or more things, and let f(xx) be their compositional fusion. Now, assume that the fusion f(xx) has some Strongly emergent property F, understood (by McDaniel) as fundamentally novel as compared to the intrinsic properties of and spatiotemporal relations between the xx.[10] McDaniel then argues that insofar as F is fundamentality novel as compared to the intrinsic properties and spatiotemporal interrelations of the xx, F can be attributed to f(xx) but not the xx—but in that case, identifying the xx and f(xx) as per CAI would violate Leibniz's Law.

As Bohn correctly notes, however, McDaniel's reasoning here fails to appreciate that there's no problem with taking the plurality xx to have a fundamental collective property. As Bohn puts it, "according to the composition as identity theorist, any emergent property of the fusion should simply be thought of as a terminological variant of a fundamental plural collective property of all the parts, and vice versa. In that way the composition as identity theorist can hold that emergent properties do not violate the principle of indiscernibility of identicals" (221). This seems right to me, and I also agree with Bohn that a similar reply is available in response to those (including Calosi, who in his 2016b argues that a version of CAI is equivalent to mereological nihilism) maintaining that mereological nihilism is incompatible with Strong emergence.

So as it stands I remain unconvinced that emergence of any variety requires that there be composed wholes of the sort that CAI denies exist, or indeed any wholes at all. Pluralities, and even a single object, will do.

All this said, I suspect that there is new work for Calosi's mereology to do, even if it is somewhat different work than that advertised. In particular, and

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[10] This characterization of Strong emergence departs in letter but not spirit from my preferred characterization, in ways related to the difference between a one-one and a one-many approach to metaphysical emergence, as discussed in Ch. 1, note 11 of my book; for present purposes nothing turns on the difference.

notwithstanding that debates over reduction and emergence have taken for granted conceptions of levels and their occupants making room, at a level, for structured as well as unstructured entities (and associated features)—such that, e.g., an atomistic physical level would contain not just atoms or pluralities of atoms, but also massively complex combinations of atoms standing in atomic relation—more work needs to be done as regards the details of how the domain of goings-on at a given level are generated. Boolean and classical mereological resources are also typically operative in generating 'lightweight' constructions of entities appropriately placed at a level, as I discuss in Ch. 1, Section 1.4.2, pertaining to the individuation of levels. Calosi and Giordani's system, and Calosi's attention to the difference between Reducible and Irreducible wholes, encode mereological resources which are both new and arguably 'lightweight.' These resources might well be added to the mix of those generating goings-on properly located at a level, and so be indirectly, if not directly, relevant to accommodating emergence, after all.

4. Replies to Emery

Emery's contribution raises a number of important questions stemming from an implementation of Weak emergence in terms of an elimination of degrees of freedom (DOF), of the sort I first offered in my 2010, and which plays a role in my book discussions of the emergence of complex systems (Ch. 5) and ordinary objects (Ch. 6). In this work, a DOF-based account is used to motivate the Weak emergence of certain special science goings-on from lower-level physical (e.g., quantum) goings-on. The overarching theme of Emery's questions concerns the extent to which attention to relations between DOF can be extended to address other cases of emergence—most interestingly, in my view, to cases of purported emergence within physics itself. A full treatment of Emery's unified set of questions deserves its own article; here I'll provide some initial response to what I see as her most pressing questions, and say a bit more about related questions in the footnotes.

Emery wonders, to start, whether a DOF-based implementation of Weak emergence might provide a fully general basis for Weak emergence—and if not, why not? To motivate my response to this question, it's worth recalling that my goal in the book is to consider whether, and ultimately to argue that, certain appearances of metaphysical emergence, drawn from both the special sciences and ordinary experience, can be taken at realistic face value. As such, I am looking to the sciences and to ordinary experience for input into which goings-on are, in those contexts and on the face of it, seemingly both dependent and autonomous in the ways characteristic of metaphysical emergence; and then my goal is to consider whether, and if so how, these appearances of metaphysical emergence can be taken at face value.

Now, a DOF-based implementation of Weak emergence reflects certain facts on the ground, including that certain special science entities are posited as having characteristic features encoded in associated special-scientific laws; that these entities are understood as composed by (systems of) lower-level entities which are also understood as having characteristic features encoded in associated (more) fundamental physical laws; and that the DOF needed to specify certain characteristic states of the former are eliminated as compared to the DOF needed to specify those same characteristic states of the latter. These facts, I argue, enter into a scientific

law-based motivation for thinking that some of the appearances of metaphysical emergence can be understood in terms of an elimination in DOF.[11]

Perhaps there are alternative ways of associating characteristic states of an entity with DOF which don't proceed by attention to scientific laws, in which case a DOF-based approach might be generalized to cover cases of Weak emergence involving such entities (or their features). But, two points. First, the availability of parameter-based accounts of characteristic states of, e.g., mountains, certain conscious mental states, or freely acting persons isn't obvious; in these cases other (e.g., functionalist or determinable-based) implementations of Weak emergence appear to be more naturally implemented.[12] Second, the conception of DOF as closely linked to certain laws plays an important role in my arguments for the conclusion that eliminations in DOF satisfy the conditions in the schema for Weak emergence, both in that the connection between DOF and laws is what blocks the reducibility of special science entities whose characterization involves eliminated DOF (since the lower-level laws require all the relevant DOF in order to operate), and in that insofar as laws express what an entity (system of entities) can or can't do, they also serve to encode what powers the entities have or don't have, in ways that suggest that entities with eliminated DOF as compared to the system of their composing/realizing entities will have fewer token powers than that system. Correspondingly, it's not clear that a DOF-based approach to Weak

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[11] On this last, Emery also asks: what is necessary for a degree of freedom to count as eliminated? It can't be that the eliminated (e.g., quantum spin) degrees of freedom are *never* relevant to the behaviour of the entity at issue, for as I note in discussing the Weak emergence of ordinary objects from quantum goings-on, one can set up scenarios (e.g., a variation on Schrödinger's cat case) where quantum phenomena do impact the behaviour of the macro-entity. This question is related, in turn, to the question of which states, with associated DOF, are taken to be 'characteristic' of a given entity. Ultimately, I think that the answer depends on what makes for the sort of non-fundamental joint in nature of the sort plausibly encoded in special science laws. I don't have a general account of what makes for a non-fundamental joint, in part reflecting my view that there are many and diverse metaphysical dependence relations operative in cases of relative fundamentality (following my 2014 and elsewhere, to be given a broad defense in my forthcoming and under contract). But perhaps traction in the present case can be gained by attention to the usual view of special science laws as containing ceteris paribus laws or clauses, which allow for exceptions; and it might also be worth exploring (perhaps drawing on the degree-theoretic variation of the account of metaphysical indeterminacy advanced in Wilson 2013 and Calosi and Wilson 2018) whether Weak emergence comes in degrees, with non-fundamental joints being to some extent fuzzy or metaphysically indeterminate.

[12] A related line of thought applies to Emery's question of whether the DOF-based Weak emergence of ordinary objects might be gained, not by way of the elimination of quantum DOF (as I do in the book), but rather by way of the elimination of broadly statistical-mechanical DOF. Indeed, I appeal to thermodynamic features as having eliminated statistical-mechanical DOF in support of certain complex systems being Weakly emergent, reflecting the applicability of renormalization group methods to such systems when near critical points, which methods track the elimination of such DOF. I focus on the quantum case in the chapter on ordinary objects mainly because, again, there's a clear scientifically endorsed line of thought which (unlike applications of the renormalization group to gasses and other complex systems) targets ordinary objects—and not because a case for Weak emergence needs to involve an absolutely fundamental base; I agree that it doesn't.

emergence can be generalized to cases where no laws are operative without undercutting the motivations for the approach in the first place.[13]

To my mind, the most pressing of Emery's questions pertains to whether and how my schemas for metaphysical emergence might accommodate cases of such emergence within physics itself. As Chalmers (2021) observes:

> Discussion of "emergent spacetime" has exploded, driven largely by theories of quantum gravity—including versions of string theory, loop quantum gravity, and causal set theory—in which spacetime may not appear on the fundamental level. […] The key thesis is that spacetime exists at a nonfundamental level and is grounded in a fundamental level which is nonspatiotemporal. (164)

(See, e.g., Lam and Wüthrich 2018 and Huggett 2021.) Not just quantum gravity (QG), but general relativity (GR) itself (as presupposing relationism; see Rovelli 2007) and quantum mechanics (QM) (if the wavefunction/configuration space is taken as fundamental; see, e.g., Albert 2013, Ney 2021) have been taken to support spacetime as emergent in that spacetime is not fundamental, but is rather completely dependent on more fundamental nonspatiotemporal goings-on. Note that the supposition that emergent spacetime (or its three-dimensional occupants) are nonfundamental indicates that the type of emergence being posited here is of the Weak rather than Strong variety.

Such applications are in prima facie tension with my schemas for metaphysical emergence. One source of tension, observed by Emery, is that the notion of cotemporal material dependence often involves the composition of the entity having the emergent feature by lower-level dependence base entities; but in the cases at issue it is unclear how elements of the more fundamental physical ontology would 'compose' the emergent physical ontology (as Baron 2019 discusses; but see Baron and Bihan 2022 for an attempt to make sense of this). Now, my own view (as I register in my replies to Calosi, above) is that compositional relations aren't required for there to be emergence, but even so, one might be concerned that the dependence condition in the schemas is too restricted to make sense of cases of purported emergence within physics. Let's focus on the purported emergence of spacetime. Recall that the dependence condition encodes substance monism, whereby the only matter is physical matter, along with minimal nomological supervenience, whereby an emergent feature S requires and is at least nomologically necessitated by ('minimally supervenes on') cotemporal base-level goings-on P. As such, the dependence condition presupposes spacetime: S is

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[13] Emery also wonders whether attention to DOF might enter into an implementation of Strong emergence, as involving a new DOF—and if not, why not? I didn't advance a DOF-based implementation of Strong emergence mainly because I didn't see clear case studies involving the posit of new DOF. As I discuss in Ch. 5 (182-5), so-called 'order parameters' are sometimes presented as involving new DOF (by, e.g., Morrison 2012 and Lamb 2015), but on closer examination no new DOF are really at issue: either the DOF are present at the micro-level, and what is new is their taking on certain values, or else the order parameters are not genuine DOF, but rather 'phenomenonological descriptions' of a system's order. That said, if there were cases where an apparently new DOF could not be given a reductive or other deflationist treatment, and given that the new DOF was associated with behaviours, law-governed or not, then a DOF-based implementation of Strong emergence might well make sense—though in such a case it's not clear that we would be adding anything new beyond the existing claim that a Strongly emergent feature has a fundamentally novel power.

cotemporal with *P*, and entities possessing these features will typically (per substance monism) share matter, hence spatially overlap.

The autonomy conditions in my schemas also presuppose spacetime: though a power may never be exercised, in any case powers are had by, and causal relations hold between, phenomena which are spatially located; moreover, accounts of causation take this to be either diachronic or synchronic, and so presuppose the notion of time.[14]

My conceptions of metaphysical emergence are not unusual in taking spatiotemporal notions for granted; effectively all standard conceptions do so. Those exploring the status of spacetime as emergent typically recognize that there is a prima facie difficulty in taking ST to be emergent by lights of standard accounts, and in response weaken the notion of emergence by removing references to space or time. There are a couple of different strategies on offer here, but in my view it is not clear that these attempts succeed—effectively, because satisfaction of the weakened conditions is compatible with either reduction or with Strong emergence, contrary to the intended characterization in these suggestions of spacetime as Weakly emergent from more fundamental nonspatiotemporal ontology.

One sort of strategy involves characterizing the dependence and autonomy conditions in ways eliding reference to spatiotemporal notions, as in Crowther's (2022) characterizations in terms of

1. dependence (cashed in terms of asymmetric supervenience correlations)
2. novelty (cashed in terms of qualitative difference)
3. autonomy (cashed in terms of multiple realizability or determination)

Crowther distinguishes 'hierarchical' emergence (a non-ST form of cotemporal emergence) where the base is somehow present, and 'flat' emergence (a non-ST form of diachronic emergence) where ST results from a non-causal 'interaction'.[15] And she argues that on certain accounts of quantum gravity, spacetime satisfies the dependence and autonomy conditions vis-à-vis the specified non-spatiotemporal basis, in hierarchical or flat fashion (and maybe both).

But granting satisfaction of these conditions in some or other versions quantum gravity, the associated weakened conception of emergence is too weak to establish that spacetime is less fundamental than what it depends on:

A's asymmetrically supervening on B doesn't entail that A is less fundamental than B.[16]

A's being qualitatively different with respect to B doesn't entail that A is less fundamental than B.

A's being multiply realized/determined by B, C, and D doesn't entail that A occupies a less fundamental level than B, C, and D; for if A is identical to the disjunction of B, C, and D (as reductionists typically maintain), A will be as fundamental as the disjunction. That is reduction, not emergence.

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[14] "The lack of a metric structure […] seems to result in the loss of causation since, on the face of it, causation requires (at least) time to exist. […] Causation is usually thought to be a relation between events, which are individuated by their spatiotemporal locations" (Baron 2019: 2208). That said, some recent conceptions of causation do not build in the notion of time; see Baron and Miller 2014 and Tallant 2019.

[15] Here the model is something like the occurrence of the big bang.

[16] For example, determinables asymmetrically supervene on determinates; but many think quantum determinables are prior to their determinate values.

A's being multiply realized/determined by B, C, and D is also compatible with the base phenomena serving as diverse preconditions for something fundamentally novel. That is Strong, not Weak, emergence.

As such, as they stand Crowther's conditions on emergence are too weak to rule out either (identity-based) reduction or Strong emergence. Moreover, on the face of it this weakness reflects the elision of spatiotemporal notions from these conditions. The best shot for establishing genuine autonomy of a Weak emergent variety proceeds by resisting reductionist and Strong emergentist readings by attention to causal considerations, and more specifically via satisfaction of the proper subset of powers condition, which blocks Strong emergence, since such emergence requires a novel power, and blocks reductionism, since disjunctive features are instanced by instancing a disjunct, and each disjunct has more token powers than are had by the Weakly emergent feature. As above, such causal notions appear to presuppose spacetime, and this is true as well on a DOF-based implementation of Weak emergence. That said, in other work Crowther (2018) suggests that a DOF-based implementation of Weak emergence can make sense of the emergence of spacetime from at least some nonspatiotemporal fundamental ontologies:

> Wilson's (2010) weak ontological emergence, where an emergent theory may be characterised by the elimination of degrees of freedom from the underlying theory […] is certainly applicable if spacetime emerges as illustrated by the condensed matter approaches to QG, and it applies to GFT, and any other approaches where spatiotemporal degrees of freedom emerge as collective, low-energy variables, analogous to those of thermodynamics. It also may apply in the context of LQG, where degrees of freedom possessed by the spin foams are eliminated in the approximation and limiting procedures designed to resolve and/or wash-out their discrete nature and quantum properties in the recovery of spacetime. (84)

These are intriguing suggestions. If Crowther is correct, and in a way I hope she is, then I would need to back off, at least for the case of spacetime, from the claim in my book that satisfaction of the conditions in the schemas is 'core and crucial' to metaphysical emergence of the sort connecting special science and fundamental physical goings-on. I'd need to say something more general.[17] Though my arguments that eliminations in DOF suffice to block reductionism and Strong emergence presuppose that DOF are associated with broadly causal laws, perhaps the same line can be implemented using a non-causal notion of information. This is something I'm working on. At present it's not entirely clear to me that there is a workable conception of Weak emergence—one which ensures dependence with autonomy—that abstracts away from causal or other spatiotemporal considerations.

A second strategy aimed at accommodating the emergence of spacetime involves appealing to a specific relation as holding between spatiotemporal and non-spatiotemporal ontology, suitable for seeing the former as dependent yet autonomous from the latter. Here the most popular suggestion appeals to something like functional realization:

> On a functionalist picture, whether an entity (a structure, object or property—from now on I will just say "structure") counts as spatiotemporal is determined by its

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[17] Or disjunctive—but that would be unsystematic.

> functional role. The functional role of a physical structure is its role in the physical laws, which often boils down to its implications about the motion of material objects. (Baker 2020: 278)

This suggestion is subject to the sort of considerations I discuss in my book when discussing functional realization in special-scientific contexts. To start, we must distinguish between 'realizer' functionalism, on which functionally implemented goings-on are identified with the realizer of the role, and 'role' functionalism, on which functionally implemented goings-on are identified with the role itself, usually understood as a kind of higher-order property. Realizer functionalism is compatible with (indeed, is a form of) identity-based reductionism, and so is unsuited for purposes of vindicating the metaphysical emergence of spacetime from nonspatiotemporal ontology. Role functionalism potentially does better; and here (following the literature in metaphysics of mind/science), what's needed is some reason to think that there exists such a second-order feature. And the usual means of doing this is by appeal to the multiple realizability of spacetime. But as I'm at pains to highlight in my book, a mere appeal to multiple realizability does not suffice to establish the irreducibility of the multiply realized feature. In particular, work must be done to rule out a disjunctive treatment of the multiple realizability at issue. And again, the main strategy for doing this (mine) appeals to causal considerations, so won't work here—though it may be that looking to eliminations of DOF is the best bet here.

But suppose it turns out that no implementation of a (nonspatiotemporal) variation of my schemas for metaphysical emergence can make sense of the purported emergence of spacetime (or its occupants). In that case, I'll here register that there are alternative, and to my mind more natural, ways of thinking about some of the relations between nonspatiotemporal and spatiotemporal goings-on than in terms of metaphysical emergence. In particular, we have in hand certain metaphysical conceptions of how concrete goings-on are related to comparatively abstract goings-on, including ones on which abstract universals (not in space and time) come to be concretely instantiated, and ones on which among the space of abstract possibilities (not in space and time), just one comes to be actualized. This last seems especially relevant to the present case; for if (following Allori) the wavefunction represents possible ways the world or objects in the world can be, then configuration space is properly seen as a modal space, with concrete goings-on being best understood as instantiations or actualizations of these possibilities. These relations—instantiation, actualization—deserve further investigation and attention. For present purposes, what is important is that there is no clear sense in which the instantiation of a universal, or the actualization of a possibility, is any less fundamental than the universal/possibility. So why think that the relation between configuration space and ordinary spacetime and its occupants entails that the latter is less fundamental than the former? Either way, the relation isn't one of metaphysical emergence per se—in which case the inability of an account of metaphysical emergence to apply to these cases doesn't pose a problem for the account. But again, as with other of the questions Emery raises, there is more work to be done in arriving at a considered answer.

5. Replies to Gozzano

Gozzano's comments address the interesting question of whether the common supposition that Weakly emergent mental features are multiply realizable—or as

he puts it, are 'realization indifferent'—is compatible with the plausible supposition that mental features are 'systematic', in entering into patterns of dependencies. Gozzano expresses the potential threat to mental features' being Weakly emergent in the form of an argument:

> (i) Mental features are systematic;
> (ii) (In many cases) Emergence entails realization indifference;
> (iii) Systematicity entails that realization indifference cannot hold;
> (iv) Therefore, (in many cases) mental features can't be emergent. (271)

(Gozzano puts aside Strong emergence, as implausible; hence here and elsewhere his references to 'emergence' are more specifically to Weak emergence.) Each premise in this argument, Gozzano maintains, can be defended; and the conclusion therefore follows.

The focus of my response in what follows is on premise (iii), but let me start by saying a bit more about (i) and (ii).

First, in re the claim that mental features are systematic. Gozzano doesn't offer a definition of 'systematicity', but does offer a number of illustrations, including cases where increases in the intensity of a perceptual stimulus are (e.g., logarithmically) systematically associated with the intensity of the phenomenal state, and cases where changes in the intensity of a phenomenal state (e.g., pain) are systematically associated with an increase in some other phenomenal state (e.g., anxiety). Though I'm not sure about the status of these particular examples, I think that what Gozzano has in mind here is that there might be relations— better, to avoid ambiguity, 'mappings'—between (to speak loosely) families of mental feature types whereby members of one family are systematically related with members of the other family. I'm happy to grant that various special science laws, including those of psychology and neuropharmacology, will at least sometimes encode these sorts of systematic mappings between (families of) mental features.

Second, in re the claim that many cases of emergence entail realization indifference, three observations. To start, I'd prefer 'involve' over 'entail', since whether a given higher-level feature is multiply realizable is an empirical, not logical, matter. Next, Gozzano's discussion involves a characterization of 'realization indifference' as building in the possibility of 'wildly different' realizers; this goes beyond the usual appeals to multiple realizability as motivating Weak emergence, which appeals often involve realizers being only 'mildly' different, as when, e.g., my belief that Paris is beautiful is realized by different neurological states, or the shape of a flock of birds is realized by different configurations of its constituent birds, will do. As such, in what follows I will usually revert to the usual terminology of multiple realizability, but will revisit whether the possibility of 'wildly different' realizers makes any difference down the line. Finally, as Gozzano notes, I don't take multiple realizability to be either necessary or sufficient for weak emergence: not necessary, since there are cases to be made that some singly realized features satisfy the proper subset condition on powers; and not sufficient, since reductionists have strategies for accommodating multiple realizability in disjunctive or other terms, which must be blocked before multiple realizability can be assumed to involve emergence. All this said, Gozzano is right that many cases of Weak emergence, of mental features in particular, are initially and primarily motivated by multiple realizability; so it is definitely worth considering

whether these suppositions are in tension with the also-plausible assumption that mental states enter into systematic mappings.

I now turn to the key premise (ii) in Gozzano's main argument—namely, the claim that 'Systematicity runs against realization indifference'.

The underlying motivation for Gozzano's endorsement of this claim appears to be a supposition that if special science properties enter into systematic mappings, then the lower-level properties upon which the special science properties cotemporally materially depend must also stand in systematic mappings. As he puts it,

> if we consider the causal relations in which [systematic special science feature] S is involved [as encoded in] high-level laws of the sort discussed by special sciences, we may require a sort of systematic counterpart of supervenience: there cannot be systematic variations at a high level without systematic variations at a low level. (272)

In this sense, Gozzano supposes, the existence of a systematic mapping between (families of) higher-level features places constraints on the realizers of these features—constraints which, he maintains, are not in place in cases of multiple realizability.

Gozzano offers a specific subargument in support of this claim and the associated premise in his main argument. In the interest of efficiency I will focus my critical attention primarily on a key premise (2) in that subargument, according to which (and consonant with the previous line of thought), if a property S is systematic,

> (2) The Ps on which S cotemporally materially depends (CMD), should follow the same pattern of systematicity shown by S. (274)

Now, it is unclear why we should accept this. As Gozzano observes:

> One may wonder why the emergentist should accept [this] premise […]. The emergentist can stress that each "level of reality" […] is characterized by its laws […] and on which S cotemporally materially depends. So, what consequences would bear [on] having different systematic relations, if any at all? (274)

The complaint here seems to me to be apropos, as far as it goes. Even granting that systematic mappings between (families of) higher-level features requires systematic mappings between (families of) lower-level features, why would these mappings have to 'follow the same pattern'? Indeed, it's not clear that higher-level systematicity mappings require lower-level systematicity mappings. All that ultimately seems required to accommodate systematic mappings involving realized features is that their lower-level realizers enter into laws compatible with those higher-level systematic mappings. Maybe those lower-level features and laws will also fall into 'systematicity patterns', but at the end of the day all that's required is that any given realizer of any given higher-level feature S provide a suitable basis for S's having the powers it needs to have to conform to whatever systematicity mappings are in place.

So, Gozzano's premise is better expressed as requiring not that realizers enter into the 'same pattern of systematicity' as S, but just that (at most) whatever laws are in place as regards S's realizer on a given occasion serve as an appropriate

basis for accommodating the systematic mappings into which S enters. To assess whether systematicity runs against multiple realizability, then, the question is whether there are reasons to think that a feature's being multiply realizable somehow poses a problem for its realizers' accommodating the systematic mappings into which S enters.

I answer in the negative; I don't see any problem here. Since at issue are cases where multiple realizability ends up motivating Weak emergence, let me put the point in my favoured terms. To fix ideas, suppose that mental features M_1, M_2, and M_3 are systematically causally connected to mental features M'_1, M'_2, M'_3; suppose also that each of these six types of mental features is multiply realizable; and suppose that (after undercutting reductionist strategies) this multiple realizability is taken to support these features' satisfying the conditions on Weak emergence vis-à-vis whatever features realize them on a given occasion. Here the systematic mapping (like Gozzano's illustrative cases) causally connects certain mental features with certain others; hence to accommodate this mapping just requires that any realizer of M_1 has among its powers the power to cause M'_1, any realizer of M_2 has among its powers the power to cause M'_2, and so on. But on the operative understanding of realization, this follows automatically, since any token power of a realized (Weakly emergent) feature on a given occasion is identical to a token power of the feature that realizes it on that occasion. So the treatment of M_1 as both multiply realized and Weakly emergent is compatible with M_1's entering into the systematicity mapping; and similarly for M_2 and M_3. So systematicity is here accommodated, notwithstanding the multiple realizabilities of the features at issue.

Note also that we were able, in this narrative, to remain neutral on whether the realizers of the mental features themselves enter into a systematicity mapping, whether similar to or different from those into which the mental features enter. Whether this is so will depend on further details about the powers and power profiles of the realizers. This bears on premise (5) of Gozzano's subargument according to which "If [the realizers] have different projectability patterns and support different counterfactuals, they do not establish the same systematic relations" (274). To be sure, the realizers can be expected to enter into different projectability patterns and support different counterfactuals (it is precisely this difference that provides a basis for thinking that Weak emergents are distinctively efficacious, in spite of not having any new powers), and let's even grant that the realizers themselves don't enter into systematic mappings at all, much less 'the same' ones into which mental states enter. None of those further details matter for whether multiple realizers can accommodate higher-level systematic mappings, as the previous case illustrates. All that matters is that the realizers have the requisite powers—as they will do, on my account of Weak emergence.

This seems to me to be a coherent narrative, indicating that there is no in-principle problem with there being systematic, multiply realizable mental (or other) features.

It remains, however, to consider two strategies for defending Gozzano's claim to the contrary. The first reflects Gozzano's characterization of multiple realizability as realization 'indifference', such that the diverse realizers at issue may be 'wildly' different—so different that they might share nothing in common:

> Let's consider pain: supposedly, in humans, it is realized by C-fiber firing, but it could be differently realized in other sentient beings and the realizers form an open set. So, we may take the property of being in pain as one that at a very high level

can be shared by different entities, from human beings to other mammals, to other animals up to potentially extra-terrestrial individuals. At a finer level of detail, being in pain is multiply realized by structures that may have nothing in common. (270)

Supposing it were the case that diverse realizers of a single feature might have 'nothing in common'—in the case of systematically related mental features, in particular—then I can see how Gozzano might conclude that systematicity runs against realization indifference. My response here is simply that I reject the supposition that realizers might 'have nothing in common', since that supposition leaves it unclear how or in what sense one feature might realize another. If, as I argue is the case for the broadly scientific (including mental) features that are the target of my book, the feature whose realization is at issue has a distinctive power profile, then at a minimum any realizer of a feature *S* has to have, among its powers, the powers of *S*. (And as I also argue, a wide range of accounts of realization, including functional realization and the determinable-determinate relation, agree.) On such an understanding of realization, effectively encoded in the schema for Weak emergence, this much will be 'in common' among multiple realizers of a feature, and as per the case above, that much seems sufficient unto the task of accommodating systematicity.

   The second strategy pushes in a different direction, and is suggested by Gozzano's discussion of what powers should be taken to be in the power profile of a given feature:

> According to the subset strategy a property is individuated by the set of its causal powers had by all its instances […] But the causal powers defining the set do have causal relations to other powers. Say, a rubber band is elastic and green. Elasticity is shared among all elastic entities no matter their color. But elasticity determines fragility in cold conditions. Should we consider this as a condition on other elastic entities? […] Should the elasticity also involve a specific ratio between, say, thickness and length of stretchability? If so, then it could be the case that only a specific realizer fits the bill. But if this is the case, then it seems Kim was right after all: each disjunct has its own merits and the high level is just a measure of our ignorance. (275)

Here one can see Gozzano as maintaining that closer examination of the powers associated with a given property indicates that powers are much more finely individuated than is usually recognized, to the extent that the claim that features, including those entering into systematic mappings (which impose yet further constraints on powers) are not appropriately seen as multiply realizable. My response starts by observing that, although this is often mainly left tacit for simplicity, talk of 'powers' in these contexts is intended as talk of 'conditional powers', such that powers are individuated not just by their effects, but also by the intrinsic and extrinsic conditions required for the powers to be manifested or exercised. Hence any given property will be associated with massively many conditional powers—not just 'the power to stretch without breaking', but 'the power to stretch without breaking if instantiated in warm conditions', and so on. All these conditional powers are had by any instance of a feature, even if the conditions of manifestation of the power do nor or even cannot obtain (as when a plastic knife has the property of being knife-shaped, which includes among its powers the power to cut wood if made of steel). This understanding strikes me as unifying and systematic,

and in line with the connection between (in particular) scientific taxonomy and laws, so I am inclined to stick with it, rather than adopting such a fine-grained conception of powers that hardly any features turn out to be multiply realizable.

To return to Gozzano's primary argument: since I can reasonably deny that 'Systematicity runs against realization indifference', I can resist Gozzano's conclusion that considerations of multiple realizability don't support the Weak emergence of mental features—especially those entering into systematic mappings.

That said, I want to close by registering that Gozzano has called something important to attention—namely, that broadly holistic considerations may turn out to be relevant to discussions of metaphysical emergence. Discussions of metaphysical emergence have tended to focus on individual cases—this mental feature, that thermodynamic feature, and so on. But how do systematicity mappings and other more global considerations bear on this topic? For example, in the case above, might M_1 and M_2 be Weakly emergent and M_3 Strongly emergent, or is there some reason to think that systematically related features should, or even must, have the same status? This is a new question, and deserves further attention.

6. Replies to Onnis

In *Metaphysical Emergence*, I motivate my powers-based schemas for Weak and Strong metaphysical emergence by attention to Kim's problem of higher-level causation, which I present as "the most pressing challenge to taking the appearances of emergent structure as genuine" (39). Onnis's contribution is aimed not at directly problematizing the schemas themselves, but at calling into question their underlying motivation in Kim's problem of higher-level causation. She aims to argue that Kim's argument proceeds against certain metaphysical presuppositions—each associated with 'Alexander's Dictum', according to which to be real is to have causal powers—which, if rejected or differently interpreted, would render the argument less of a challenge so far as accommodating emergence is concerned. As she summarizes:

> [T]here are three issues that need to be addressed. The first one concerns the Dictum itself: one may want to reject it and assume other criteria about existence. The second one is about the power-based interpretation of the Dictum: one may want to accept the latter, while considering its power-based interpretation as too strict. The third one is about the metaphysical underdetermination of the powers involved in the power-based interpretation: one may want to accept the Dictum and its power-based interpretation, while requiring a differentiation between microscopic physical powers and macroscopic emergent powers. (296)

Since the problematic presuppositions at issue concern powers, one can see Onnis here as pushing back not just on the stated motivations for my schemas, but more pressingly on my claim that the powers-based schemas are 'core and crucial' to metaphysically accommodating the appearances of emergence.

The considerations that Onnis raises are well worth attention. Even so, as I will now argue, at the end of day the metaphysical presuppositions she identifies as underpinning Kim's problematic are not required for this problematic to put pressure on the viability of metaphysical emergence; hence the motivation for my powers-based schemas as indeed 'core and crucial' to accommodating such emergence remains.

6.1 Alexander's Dictum

As discussed in the *Précis*, I set out Kim's overdetermination problem as involving six premises, four of which (Reality, Distinctness, Efficacy, and Dependence) encode certain assumptions about the seeming higher-level features at issue, and two of which (Physical Causal Closure and Non-overdetermination) encode certain assumptions about causation. The basic concern is that any purported effect of a (real, distinct, dependent) higher-level feature is (per Closure) already brought about by the lower-level physical goings-on upon which the higher-level feature depends, and so is (contra Non-overdetermination) overdetermined. As I observe, standard responses to Kim's argument are associated with certain views, denying some or other premise. Of these views, only those denying Physical Causal Closure (i.e., British emergentism) or Non-overdetermination (i.e., non-reductive physicalism) accommodate metaphysical emergence, understood as coupling co-temporal material dependence with ontological and causal autonomy (distinctness and distinctive efficacy); and the strategies encoded in these two views motivate my schemas for emergence, whereby a higher-level feature has a fundamentally novel power as compared to its dependence base feature on any given occasion (Strong emergence), or a higher-level feature has a proper subset of the token powers of its dependence base feature on any given occasion (Weak emergence).

Now, Onnis maintains that Kim's overdetermination argument presupposes Alexander's Dictum (after British emergentist Samuel Alexander), commonly spun (e.g., by Kim 2006: 557) as the thesis that 'to be is to have causal powers'. To start, Onnis observes, Kim takes Alexander's Dictum to motivate the Efficacy premise in his argument (perhaps given the Reality premise in his argument), insofar as he registers that "to be a mental realist [...] mental properties must be causal properties" (1998,: 43). Moreover, in his (2006), Kim goes further, saying "Properties that are lacking in causal powers—that is, whose possession by an object makes no difference to the causal potential of the object—would be of no interest to anyone" (557), again connecting this thesis to Alexander. Onnis goes on to claim that Kim's problem requires and gets traction only under the assumption of Alexander's Dictum:

> If the principle is rejected, entities can have a legitimate existence even without exerting causal efficacy. If the nonreductive physicalist has to give up her nonreductionism, therefore, it is because of Alexander's Dictum. (292–93)

I respond that it isn't clear either that Kim accepts Alexander's Dictum, or that Kim's problem gets traction only if one assumes this Dictum. As regards Kim's own proclivities, it is worth noting that his expressions of claims in the ballpark of Alexander's Dictum (as in his 2006, above) are uniformly offered in a context within which he is presenting the emergentist's point of view, as opposed to his own. In any case, Alexander's Dictum is very broad; it aims to provide a general necessary condition on the existence of goings-on of any ontological category whatsoever. As such, one might reject the Dictum in full generality—perhaps because one believes that platonic universals or numbers exist, but don't have causal powers—yet still maintain that for scientific or concrete entities and features, to be is to have causal powers. Indeed, Kim's focus in his discussion of overdetermination is squarely on broadly scientific features, so it isn't obvious that he intends

to advance anything as strong as Alexander's Dictum, understood as a general criterion of existence.

That said, Onnis is correct that Kim's problematic takes as a premise that mental (more generally: special scientific) features have powers, as per Efficacy. But we don't need Alexander's Dictum to motivate this premise. Independent of that Dictum, the efficacy of special science features is motivated by their entering into special science laws which standardly express causal regularities (chemical reactions, geological forces, biological processes, predator-prey relationships, neurological and psychological interactions, and so on). And we moreover have direct experience of the seeming efficacy of the qualitative mental features that are Kim's primary focus, as is reflected in nomological truisms such as that (ceteris paribus) being in pain causes avoidance behaviour, being hungry causes one to seek out food, and so on.

These independent motivations for taking the higher-level features at issue in Kim's problematic to be efficacious would remain even if one rejected Alexander's Dictum, either in full or in part, perhaps on grounds (as Onnis suggests) that certain motivations for thinking that some goings-on exist don't explicitly require the efficacy of said existents.[18] It would remain that there are theoretical (law-based) and experiential reasons for thinking that mental and other special-scientific features are efficacious; and given the other premises in Kim's argument, his challenge for there being emergent higher-level goings-on would unfurl accordingly. To be sure, the epiphenomenalist responds to Kim's problematic by denying Efficacy; but to offer an epiphenomenalist response to Kim's problematic is not to say that there was never a problematic there in the first place. On the contrary, in the dialectical course of events the burden is on the epiphenomenalist to explain away the science-based and experience-based motivations for Efficacy—a burden not easily discharged, which may account for the relative paucity of epiphenomenalists.

6.2 A Heavyweight Notion of Powers?

I next turn to Onnis's claim that, even granting Alexander's Dictum (at least as applied to mental and other scientific features), Kim's interpretation of the Dictum presupposes a conception of efficacy as involving powers that are real in some metaphysically heavyweight sense. As Onnis interestingly argues, such a conception appears to be at odds with Alexander's own comparatively lightweight correlational conception of efficacy. She moreover suggests that a heavyweight conception of powers "seems to already carry anti-emergentist implications", insofar as such powers are a ready target of reductionist strategies. For example, Onnis observes that on one implementation of Taylor's (2015) 'collapse' objection to the viability of Strong emergence, any purportedly fundamentally novel powers at the

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[18] By way of such alternative motivations, Onnis considers being introspectively accessible (as I suggest provides defeasible motivation for our taking libertarian free choice to exist) or being indispensible to our best science. Introspection of free will seems to me to satisfy Alexander's Dictum twice over, insofar as a free choice causes both the awareness of the choice and the outcome of the choice. Indispensibility considerations look better by way of a genuine alternative motivation for existence—perhaps causally inert mathematical entities are required for our best theories. In any case, the availability of such alternative motivations doesn't undercut the specifically causal considerations which motivate mental and other special-scientific goings-on.

higher level can be traced to dispositional properties of base-level constituents. Onnis suggests that less committal conceptions of the efficacy at issue "seem to make the problem of higher-level causation less challenging".

It is true that Kim frames his problematic in terms of powers, as in his Causal Inheritance principle and elsewhere. So far as I can tell, however, all that Kim has in mind in his talk of 'causal powers' associated with a given property is that the having of the property 'makes a difference' to the causal potential of an object—that is, to what the feature (or an object having the feature) can cause when in certain circumstances. Such an understanding is in line with the metaphysically neutral understanding of powers operative in *Metaphysical Emergence*, according to which talk of powers is talk of the contribution that the having a property can make, when instanced in appropriate circumstances, to the production of a given effect. This neutral understanding does not require that powers be understood as dispositions or in any other heavyweight terms; as I argue (33), even a contingentist categoricalist Humean could accept powers in the sense operative in the schemas.

In any case, suppose that the operative notion of efficacy/causation and associated use of 'power' is given a weak—say, Humean—reading in Kim's problematic. Would Kim's argument then pose less of a threat to accommodating the appearances of higher-level reality, as involving emergent special science features? One motivation for a positive answer might proceed as follows. To start, consider the sort of scenarios that are not supposed to be good models for making sense of higher-level causation: namely, firing squad or double-rock-throw cases. Why think that it would be problematic if mental or other special science causation were overdetermined like this? The concern seems to reflect a kind of 'oomphy' understanding of efficacy, where different causes directed at the same effect would, like different substances trying to occupy the same space, get in each others' way. And perhaps such an 'oomphy' understanding is more naturally associated with a heavyweight notion of powers, as real dispositions or the like.

But even supposing a more metaphysically substantial notion of efficacy or power provides one route to finding causal overdetermination problematic, it isn't the only way. Another route simply lies in observing that, whatever the right account of causation, and whatever (in particular) is going on in firing squad and double-rock-throw cases, it remains that mental causation is *not that kind of case*—the relation between the mental goings-on and their physical dependence base is just different from those sorts of overdetermination cases. And yet certain of the premises in Kim's argument suggest that higher-level features would overdetermine the effects of their lower-level bases. That's really all that the 'Non-overdetermination' premise is registering; and Humeans as well as non-Humeans can and typically do agree that this is enough to get the problematic going.

Moreover, just because one accepts a Humean or other lightweight understanding of causation and associated talk of 'powers', or prefers to dispense with talk of powers altogether (even as shorthand for saying what can cause what), it isn't clear that the problem of higher-level causation thereby becomes less challenging. As I observe in Wilson 2002, if causal power is understood just as a matter of nomological sufficiency (in the circumstances), then insofar as base-level properties are nomologically sufficient for higher-level properties, and nomological sufficiency is transitive, then any power purportedly had by the higher-level

property will also be had by the base property.[19] Hence a version of the Collapse objection against Strong emergence attaches even to a lightweight conception of efficacy/powers.[20] And as I also observe in Wilson 2002, if causal power is understood just as a matter of nomological necessity (in the circumstances), then in any case where the higher-level property is multiply realizable, then the physical base-level property will be ruled out as efficacious.[21] In that case it would appear that Physical Causal Closure is violated, and Kim's problematic again comes into play, illustrating a prima facie challenge in reconciling higher-level causation with a broadly physicalist world-view.

So the force of Kim's problematic overdetermination argument does not hinge on commitment to a heavyweight conception of efficacy or powers. Luckily, or so I argue in my book, physicalists and non-physicalists alike have the resources, either in general or via appropriate implementations of the schemas for Weak and Strong emergence, to respond to the full range of ways in which Kim's challenge may be brought to bear.

6.3 Microscopic vs. Macroscopic Emergent Powers

Finally, I turn to Onnis's claim that taking there to be a "difference in kind" between higher-level and lower-level powers "might be able to weaken the problem of high-level causation":

> By examining the nature of causal powers, for instance, it might be discovered that higher-level powers cannot really collapse, while lower-level ones cannot really emerge. Emergent and non-emergent causal powers, in other words, might simply be non-interchangeable powers of a different kind. (300)

Onnis goes on to offer a preliminary characterization of the difference between 'emergent' and 'non-emergent' powers. The latter, she suggests, are associated with properties of micro-objects (e.g., the mass of an electron), and are commonly thought to be "fundamental, essential, intrinsic, intrinsically active, and productive". The former are associated with properties of macro-objects (e.g., the hardness of a diamond), and "are often conceived as nonfundamental, extrinsic, context-sensitive, and constraining", as on Gillett's (2016) understanding of 'machresis' as a form of non-productive 'role-shaping' determination. Onnis speculates that "the most striking difference between micropowers and emergent powers would therefore be the intrinsic activity and productivity of the former and the

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[19] As I there illustrated: "[S]uppose one of my brain properties necessitates one of my mental properties, and the mental property bestows some causal power on me. [If] causal power bestowal is just a matter of nomological sufficiency, my brain property will, in virtue of necessitating the mental property, also bestow this causal power on me" (Wilson 2002: 64).

[20] I respond to this and other versions of the Collapse objection in my book (drawing on Wilson 2002 and Baysan and Wilson 2017), but the present point is just that the threat of Collapse does not hinge on a heavyweight conception of efficacy/powers.

[21] As I there illustrated: "The general idea is this: suppose either of two of my brain properties is sufficient for one of my mental properties, and the mental property bestows some causal power on me. Since we're assuming that causal power bestowal is a matter of nomological necessity, as well as sufficiency, and since neither brain property is necessary for the effect in question, neither brain property will bestow this causal power on me" (Wilson 2002: 65).

extrinsic non-productive constraining capacities of the latter" (300). And re the Collapse concern, she suggests that

> differentiating between micropowers and macropowers might make this collapse more difficult. For instance, let's suppose that the macroscopic causal powers exerted by a biological complex system require a biological complex bearer. In that case, a nonbiological system or a biological isolated component could not instantiate those macropowers, which would therefore become non-collapsible. (300)

Onnis notes that these suggestions are preliminary, but even so let me say why I'm not inclined to take on board any such distinction in kinds of powers. To start, I don't speak of 'emergent powers' (or non-emergent powers); it is features, or perhaps entities having the features, which are emergent (or not) on my view. And as above, the conception of 'power' operative in my book encodes just that (talk of) powers associated with a given feature is (talk of) what contributions the having of the feature may make to the production of certain effects, when in certain circumstances. Such a neutral characterization makes sense, so far as I can tell, whatever sort of feature or entity is at issue. Nor would I be inclined to endorse a conception on which emergent and non-emergent features (or associated powers) differ in fundamentality status, both because Strongly emergent features (powers) are just as fundamental as whatever fundamental physical features (powers) there might be, and because the physical features (powers) serving as a co-temporal dependence base for higher-level features (powers) will themselves typically be features of highly complex micro-configurations, and so not themselves be fundamental. I would also resist any general characterization of emergent features (powers) as 'constraining', not just because cases of Strong emergence needn't involve constraints, but also because cases of Weak emergence needn't do so (as on a determinable-based implementation); and even when Weak emergence does involve constraints, it is lower-level goings-on, not higher-level powers, which impose the constraints (as on the degrees-of-freedom-based implementation discussed in §5.2.4 of my book).

That said, I agree with Onnis that further investigations into the nature of powers might open the door to new strategies for responding to at least some concerns about emergent features. Indeed, Onnis's suggested response to the Collapse objection is quite similar to the 'new bearers' strategy which I discuss in Ch. 4 (135), which appeals to Baysan's (2016) view that features have their powers derivatively on the powers of their bearers. But note that whether one wants to go this route to avoid Collapse will depend on whether one is inclined to accept Baysan's view (which as it happens, I'm not). Moreover, the question will remain of whether the macrofeatures (powers) at issue in a given case are or are not in line with physicalism—which brings us back to the terrain of Kim's problematic.

To sum up: while it's worth asking whether Kim's problematic is generated by Alexander's Dictum or related controversial assumptions, my general answer is 'no, it isn't so generated'; and similarly for the Collapse concern for Strong emergence. Rather, these problematics are surprisingly robust across heavyweight and lightweight conceptions of efficacy and powers. As such, for those aiming to realistically accommodate the appearances of metaphysical emergence, the powers-based responses encoded in the schemas for Weak and Strong emergence remain the only game in town.

7. Replies to McLaughlin

In his contribution, McLaughlin raises several important questions about or concerns for my views. My responses here will focus on the following: first, whether my 'no fundamental mentality' account of the physical needs to embrace further constraints; second, whether satisfaction of the conditions in the schema for Weak emergence is either necessary or sufficient for physical acceptability; and third, whether Strong emergence, understood as involving fundamental powers or associated interactions which come into play only at certain levels of compositional complexity, is compatible with quantum field theory.

I start with a quick clarification. McLaughlin describes my account of the physical as one according to which the physical "[…] is whatever would be posited by the completed physics in fact true of our world, with the following caveat: A mental feature is not to be counted as a physical feature even if that physics would posit it" (280); and he describes the associated constraint on physicalism as one according to which "any doctrine deserving of the name "physicalism" should be incompatible with the physics in fact true of our world having to posit mental phenomena" (280). If by a 'posit' of physics we just have in mind the (most) fundamental entities or features treated by that theory, then these descriptions coincide with my account of the physical and the associated constraint on physicalism, respectively. But since physics also in some sense posits non-fundamenta (e.g., protons and other particles composed of quarks) and more generally treats certain non-fundamental complexes (e.g., pluralities or relational aggregates), it's worth being clear that what I rule out as 'physical' are any goings-on that are (as I put it) 'fundamentally mental', in being both (a) fundamental and (b) individually such as to have or bestow mentality, of the sort, e.g., that panpsychists suppose exist—hence the 'no fundamental mentality' (NFM) constraint. The NFM account is compatible, e.g., with physics treating non-fundamental physical states (consisting of some massively complex combination of fundamental physical goings-on) that are either identical with (as on a reductive physicalist view) or which realize (as on a non-reductive physicalist view) mental features.

Now, in re my NFM account of the physical, McLaughlin considers whether I would accept further constraints on the physical—e.g., a 'no fundamental chemical' and 'no fundamental biological' constraints—and speculates that I would do so:

> I think [Wilson] would […] accept such additional constraints. It is clear, for instance, that if the physics in fact true of our world would have to posit entelechies or a fundamental vital force, she would take physicalism to be false. (280)

McLaughlin doesn't present the potential need to introduce further constraints as an objection, but other things being equal, I would prefer not to introduce such further constraints, since it seems to me that doing so would be unsystematic. As I earlier put it:

> One might wonder whether imposing the NFM constraint leads to an unsystematic account of the physical. The NFM constraint is motivated by […] intuitions to the effect that physicalism would be falsified if there turned out to be fundamentally mental entities. But intuitively, physicalism would also be falsified if we were to find that entities at relatively low orders of constitutional complexity were moral

or freely acting agents, or that aesthetic responses involved a new fundamental interaction or force. Similarly (recalling Driesch and Broad) for chemical, biological and other non-mental, seemingly higher-order features of reality. […] So shouldn't those endorsing a physics-based account of the physical impose, in addition to the NFM constraint, no fundamental morality, no fundamental free will, no fundamental aesthetics, no fundamental chemistry, no fundamental biology, and no miraculous powers constraints? But then, the concern goes, the resulting account of the physical will be unsystematic and ad hoc; for what are mentality, morality, aesthetics, chemistry, biology, and miracles supposed to have in common, that rules them out as being physical? (Wilson 2006: 75)

In my 2006, I aimed to avoid such further constraints in a 'divide and conquer' fashion. As regards fundamental chemistry and biology, I said

> Given that chemical and biological features of reality can, in actual fact, be ontologically accounted for in terms of configurations of […] entities that are not themselves chemical or biological (as all parties to the physicalism debates seem generally prepared to agree), there is no need to explicitly rule these out as being […] fundamental […]. (75)

And for the rest, I argued that insofar as each plausibly involves mentality, no constraint beyond the NFM constraint is needed (76).

This divide and conquer strategy still seems to me to work, but in re the potential need for 'no fundamental chemistry' or 'no fundamental biology' constraints, I now think that something more principled can be said—namely, that these constraints are not needed because chemical and biological goings-on, unlike mental goings-on, are essentially such as to be or be features of comparatively compositionally complex phenomena, such that it would make no sense for individual fundamental physical goings-on, which by the definition of physics are comparatively non-complex, to have chemical or biological features. McLaughlin's question made me realize that there is an important difference here as regards the potential threat of non-mental and mental phenomena so far as characterizing the physical is concerned; for while chemical and biological phenomena might be fundamental in being Strongly emergent (since the advent of such emergence is compatible with, and typically involves, compositional complexity), they could not be fundamental in the sense of being or being features of compositionally basic phenomena. Hence it is, perhaps, that no correlates of panpsychism (panchemism, panbiologism) have been advanced for either chemical or biological features of reality.

I turn next to two concerns that McLaughlin raises for my account of Weak emergence. The first has to do with the whether satisfaction of the conditions in my schema for Weak emergence suffices to render Weak emergents physically acceptable (given the physical acceptability of the base level goings-on). McLaughlin thinks not:

> The nomological requirement on Weak emergence is that if a feature S Weakly emerges from a physical feature P, then P is minimally nomologically sufficient for S. That condition is compatible with the law linking S and P being a fundamental law of nature, a law that doesn't hold in virtue of other laws and conditions. […] The existence of fundamental [e.g.,] psychophysical laws is incompatible with physicalism, reductive or non-reductive. […] To avoid this result, the

condition of cotemporal material dependence must be amended […] to include the requirement that the law linking S and P not be a fundamental law of nature; it must be a law that holds in virtue of physical laws and physical conditions (284).

I see McLaughlin's point as in a similar vein to a concern raised by Melnyk (2006). In *Metaphysical Emergence* I present the general concern as follows:

> [W]hatever makes it the case that some proper subsets of token powers of a given lower-level physical feature correspond to (instantiated) higher-level features, while other subsets do not do so, had better itself be physically acceptable if the higher-level features are to be physically acceptable; yet satisfaction of the conditions in Weak Emergence is silent on why a given higher-level feature S has the distinctive power profile it has, and so is compatible (one might think) with the instantiation of a higher-level feature's being, somehow or other, the outcome of a physically unacceptable process. (106)

One can develop the concern by noting (as I do in Wilson 2010) that the satisfaction of the proper subset of powers condition is frequently associated with the holding of certain lower-level constraints; as Melnyk correctly observes, if the holding of these constraints ensues as a matter of some physically unacceptable process (say, if the constraints hold as a matter of God's will), then the physical acceptability of the higher-level feature would be thereby undercut. In my 2010, I explicitly require that the constraints at issue be a matter just of physical or physically acceptable processes, and in *Metaphysical Emergence* I register that if an amendment to the schema for Weak emergence is needed, it would likely involve explicitly incorporating this sort of requirement (107).

McLaughlin's comment can be seen as developing the concern in a way that does not specifically advert to constraints, by attention to the possibility that emergent and base features are connected by fundamental laws, as makes sense for Strong but not Weak emergence. And here too I would say that there may well be a case for making the sort of amendment McLaughlin suggests, and requiring that any laws holding between base-level and Weak emergent features hold solely in virtue of physical laws and conditions. That said, rather than bifurcating accounts of the cotemporal material dependence condition which at present is common to the schemas of Weak and Strong emergence, I would prefer to insert any such amendment into the autonomy condition on Weak emergence, to the effect of requiring that any constraints *or laws* operative in making it the case that a given feature is associated with only a proper subset of the token powers of the lower-level base feature be constituted or otherwise determined by lower-level physical processes and/or laws.

McLaughlin also raises the concern that satisfaction of the conditions on Weak emergence is not necessary for metaphysical emergence of a physically acceptable variety. In particular, he suggests that on a 'role-functionalist' view taking higher-level states to be second-order functional states "of being in some state or other that has certain causal effects [where] the first-order states that have those effects realize the functional state" need not be understood as imposing the autonomy (proper subset of powers) condition:

> It is open to a role functionalist to maintain that a functional state, a state of being in some state or other that has certain effects, does not itself cause those effects. Its

realizers do. That's compatible with functional states figuring in causal explanations of the effects in question. But it is incompatible with Weak emergence. (285)

McLaughlin's suggestion here seems to reflect his position that, while role-functionalism "cannot avoid epiphenomenalism" (McLaughlin 2006: 39), this much does not prevent role-functionalists from adopting "a weaker notion of causal relevance" (one not requiring of a causally relevant feature that it actually cause anything) on which it suffices for a feature to be causally relevant that it be causally 'explanatory'—say, by "providing information about the causal history of an action". Here I'll just say that such a weak understanding of causal relevance is too weak to capture the sense in which we want higher-level features to be efficacious—e.g., as entering into seemingly causal special science laws, or as mental causes of our agential behaviours. Relatedly, such a weak notion of relevance seems ripe for reductive or eliminativist treatment of role-functional features in (mere) conceptual or pragmatic terms (per, e.g., Heil 2003). So on the assumption that role-functionalist features are epiphenomenal, that they don't satisfy the conditions for Weak emergence doesn't pose a problem for my view. That said, it seems to me that role-functionalists can resist the charge of epiphenomenalism, and more specifically can maintain that such properties satisfy the conditions in Weak emergence, for reasons I set out in my book (Wilson 2021: 59–60).

Finally, I turn to McLaughlin's concern that Strong emergence, understood (as on my preferred implementation) as involving a novel fundamental interaction, is incompatible with current physics—in particular, with quantum field theory (QFT), which aims to unify quantum mechanics and special relativity, and is the foundation of the standard model of fundamental particle physics:

In the field dynamics of quantum field theory, interactions are *local*. They are local in that fields directly interact with other fields only at spacetime points. That is to say, the dynamics of each field at any spacetime point are directly influenced only by the values and derivatives of the other fields at that same point, and not by anything happening elsewhere. That fundamental interactions are local is inextricably baked into the theory. Quantum field theory could, for instance, accommodate new kinds of particles and new kinds of fundamental forces. But the discovery of fundamental configurational interactions would refute the theory. It thus isn't just that quantum field theory doesn't now posit fundamental configurational interactions, it cannot countenance them. Such direct fundamental interactions would involve whole regions of spacetime. That is incompatible with relativity theory. (288)

More specifically, McLaughlin goes on, the enormous success of QFT defeats the considerations I offer for thinking that there is libertarian free will (to wit: that we have direct experience of ourselves as choosing, and that there are presently no good reasons for thinking that we cannot take this experience at realistic face value):

Quantum field theory has been enormously successful in its regime of applicability, and [...] human brains fall well within that regime. The truly enormous empirical support quantum field theory enjoys soundly defeats any intuitions we might have about there being a fundamental force of will. (288)

I offer four lines of response to McLaughlin's objection.

First, it is incorrect that the supposition that fundamental interactions are local, in the sense that fields directly interact only at points, is "inextricably baked into" QFT.[22] To be sure, standard quantum field theory textbooks often claim that interactions are local in this sense, but (as claims in textbook presentations of physical theories often are) this claim is a gloss, which upon closer examination is metaphysically, theoretically, and historically inaccurate.

The usual gloss is metaphysically inaccurate—or at least, metaphysically suspect. To start, field operators are not definable at points unless the theory is fully regulated (rendered non-divergent) in the UV regime. In continuum QFT, field operators must be treated as operator-valued distributions—i.e., one only gets an operator by integrating the distribution against a test function with support on a compact region (i.e., by averaging the field values in a small region around the point), which results in a field observable that is not even gauge invariant. The metaphysical picture encoded in this procedure is murky, and if anything seems to suggest that fields interact not at points, but rather in the compact vicinity of points.[23] Relatedly, the usual means of dealing with UV divergence in local QFT results in a QFT which is an 'effective' field theory, the import of which is precisely to gloss over what exactly is happening at the small-scale limit. Physicists have identified tools (most saliently: renormalization strategies) enabling QFT to be useful for capturing the long distance physics while allowing us to remain agnostic about the short distance physics. But given this understanding of effective QFT, it's clear that there are lots of ways the short distance physics could be. Indeed, there is nothing in QFT itself qua effective theory that demands that what lies below the limit of applicability is even a quantum field theory, much less one that is local (or nonlocal)![24]

The usual gloss is also theoretically and historically inaccurate, since as it happens attention to nonlocal QFT goes back at least to the 1940's and is alive and well today. As Tomboulis (2015) recently put it:

> Nonlocal field theories is a subject with long, albeit spotty, history. Despite the success of perturbative renormalization in QED in the late forties, the idea that local interactions may be a low energy approximation to fundamental underlying nonlocality of interactions continued to be prominent in the fifties and the subject of many investigations [1].[25] Subsequently, nonlocality was considered mostly in

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[22] Thanks to Michael Miller and Patrick Fraser for helpful discussion here.

[23] See also the discussion of the 'localization problem' in Saunders 1992.

[24] This is an epistemic point. Interestingly, however, certain metaphysical readings of the effectiveness at issue (say, as involving a lower limit to the precision of the field values, per Miller forthcoming) might also undercut the claim that interactions in QFT occur at points in a continuum.

[25] "[1] R.P. Feynman, Phys. Rev. 74, 939 (1948); A. Pais and G. E. Uhlenbeck, Phys. Rev. 79, 145 (1950); P. Kristensen and C. Møller, Dan. Mat. Fys. Medd. 27, no. 7 (1952); W. Pauli, Nuovo Cimente, 10, 648 (1953); M. Ebel, Dan. Mat. Fys. Medd. 29, no. 2 (1954); M. Chretien and R. E. Peierls, Nuovo Cimento 10, 668 (1953); M Cretien and R. Peierls, Proc. R. Soc. London A223, 468 (1954); C. Hayashi, Prog. Theor. Phys. 10, 533 (1953); ibid, 11, 226 (1954); N. Shono and N. Oda, Prog. Theor. Phys. 8, 28 (1952); F. Bopp, Ann. d. Physik, 42, 573 (1942); H. Mc Manus, Proc. R. Soc. London A195, 323 (1948); G. Wataghin, Z. Phys. 86, 92 (1934)" (26).

the context of axiomatic field theory [2].[26] In more recent years it has attracted renewed interest in connection with nonlocal theories of gravity [3] - [9],[27] as well as the nonlocality of string field theory vertices and various nonlocal models in cosmology and other areas, see [10][28] and extensive reference list therein. (2)

Others advancing versions of nonlocal QFT include Nobel laureate H. Yukawa,[29] K. Namsrai,[30] G. Fleming,[31] M. Moffat,[32] and R. Landry and J. Moffat.[33] It's clear, then, that physicists do not see the locality of interactions as "inextricably baked into QFT".

There's good reason why nonlocal QFT is of perennial interest as an alternative research program to local QFT. It's not just that local QFT is subject to UV divergence, though that is part of what drives physicists to look elsewhere. As Fleming (1987) observes, the original and continuing motivation for exploring nonlocal QFT reflects concerns "over the internal consistency of a theory requiring infinite renormalization and the long-standing recognition that local interactions generate that requirement". As above, getting any predictions out of QFT requires adopting perturbative methods involving expansions which, unless arbitrarily cut off, give rise to infinities. To be sure, "at the level of comparing renormalized perturbation theory calculations with experiment …[t]he methods work wonderfully!" Still …

> [T]hrough all these years since Dyson, Feynmann, and Schwinger formulated renormalization theory, it has never shed its fundamentally *ad hoc* character. It remains a recipe for extracting finite results from an infinity-plagued formalism by cancelling the infinities against one another systematically. What is wanted is a formulation of non-trivial interacting QFT that never encounters the infinities in the first place. (Fleming 1987: 98–9)

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[26] "M. Meyman, Sov. Phys. JETP 20, 1320 (1965); V. Efimov, Com. Math. Phys. 5, 42 (1967); ibid, 7, 138 (1968); M. Z. Iofa and V. Ya. Fainberg, Theor. Mat. Fiz. 1, 187 (1969); M. Z. Iofa and V. Ya. Fainberg,, Sov. Phys. JETP 29, 880 (1969); V. Ya. Fainberg and M. A. Soloniev, Ann. Phys. 113, 421 (1978); V. Ya. Feinberg and M. A. Soloviev, Theor. Math. Phys. 93, 1438 (1992)" (26–27).

[27] "E. T. Tomboulis, arXiv:hep-th/9702146; [4] T. Biswas, E. Gerwick, T. Koivisto and A. Mazumdar, Phys. Rev. Lett. 108, 031101 (2012) [arXiv:1110.5249]; [5] T. Biswas, A. Conroy, A. S. Koshelev and A. Mazumdar, Class. Quant. Grav. 31, 015022 (2014) [arXiv:1308.2319]; [6] L. Modesto, Phys. Rev. D 86, 044005 (2012); [7] L. Modesto, Astron. Rev. 8.2, 4 (2013) [arXiv:11202.3151]; L. Modesto, arXiv:1402.6795[hep-th]]; F. Briscese, L. Modesto and S. Tsujikawa, Phys. Rev. D 89, 024029 (2014) [arXiv:1308.1413]; G. Calcagni and L. Modesto, Phys. Rev. D 91, 124059 (12015) [arXiv:1404.2137 [hep-th]; L. Modesto and L. Rachwal, Nucl. Phys. B889, 228 (2014) [arXiv:1407.8036]. [8] M. Isi, J. Mureika and P. Nocolini, JHEP 1311:139 (2013) [arXiv:1310.8153 [hep-th]]. [9] V. P. Frolov, arXiv:1505.00492; V. P. Frolov, A. Zelnikov and T. de Paula Netto, arXiv:1504.00412" (27).

[28] "N. Barnaby and N. Kamran, JHEP 0802, 008 (2008)" (27).

[29] See in particular Yukawa 1950a and 1950b.

[30] See, e.g., Namsrai 1986.

[31] See, e.g., Fleming 1987.

[32] See, e.g., Moffat 1990.

[33] See Landry and Moffat (forthcoming).

The deeper motivation for exploring nonlocal QFT is that the assumption of locality itself underlies UV divergence. As Tomboulis (2015) puts it:

> It has long been realized, more or less explicitly, that UV finiteness (or at least superrenormalizability in the presence of gauge interactions) can be achieved by nonlocal interactions. (2)

Of course, UV finiteness isn't the only theoretical desideratum. In addition, theorists want QFT to satisfy unitarity and causality, in a way compatible with relativity. Tomboulis goes on:

> [On nonlocal QFT], unitarity can be preserved, at least perturbatively, provided appropriate analyticity conditions can be imposed on the nonlocal interactions. Causality, however, is a central concern whose investigation has remained woefully inadequate, both in the classical theory, where it is inexorably connected with the mathematically proper formulation of the initial value problem (IVP), and in the quantum theory. (2)

In any case, many nonlocal versions of QFT claim to avoid UV divergence while accommodating both unitarity and causality. For example, Namsrai (1986) constructs "a nonlocal theory of quantized fields by means of the hypothesis of *spacetime stochasticity*", and Fleming (1987) formulates a nonlocal QFT involving spacelike hyperplanes:[34]

> Hyperplane dependence of the dynamical variables of quantum theory, and consequently, their eigenvectors, is the minimal generalization of the concept of time dependence that is required to establish a manifestly Lorenz covariant formalism. […] The reason that hyperplane dependence has not previously become a prominent conceptual tool of theoretical physics [reflects that] contemporary fundamental theories of many-particle systems are expressed in terms of basic quantized fields that are themselves associated with simple points of space-time. [But this line of thought] may be unnecessarily restrictive. The experience my students and I have gained, in exploring the possibilities, allowed for interactions of particles with external potentials when hyperplane dependence is explicitly incorporated into the formalism, and suggests the possibility that consistent Lorentz-invariant quantum field theories with nonlocal interactions may be possible if the fields are hyperplane-dependent. I will suggest below a model of such a theory. (97–8).

In discussing Fleming's view, Saunders (1992: 379) suggests that a relaxing of the demand for local covariance, to be replaced in particular by the weaker requirement of hyperplane dependent covariance, may well be "all but inevitable". Yet more recently, Landry and Moffat (forthcoming) say:

> We discuss the nonlocal nature of quantum mechanics and the link with relativistic quantum mechanics such as formulated by quantum field theory. We use here a nonlocal quantum field theory (NLQFT) which is finite, satisfies Poincaré

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[34] A spacelike hyperplane is a three-dimensional, metrically flat section of the flat Minkowski space-time continuum, such that any two points in the hyperplane are separated by a spacelike interval, and such that for any such hyperplane, there is an inertial frame of reference in which all the points of the hyperplane are simultaneous, and all points simultaneous with any point of the hyperplane are in the hyperplane.

invariance, unitarity and microscopic causality. This nonlocal quantum field theory associates infinite derivative entire functions with propagators and vertices. We focus on proving causality and discussing its importance when constructing a relativistic field theory. […] The result is free of UV divergences and we recover the area law.

Suffice to say that nonlocal QFT is a research program with a long history that people are still actively pursuing.[35]

Third, it's not clear that any Strong emergence there might be would violate microcausality. To start, note that any demand for locality in QFT had better be compatible with entanglement; and indeed it is, since the locality characteristic of QFT is one supposed to preserve "microcausality", whereby no causal influences can travel faster than the speed of light. Entanglement phenomena don't violate microcausality, and so don't violate locality in that sense; rather, they violate separability, according to which the wave-function for the system as a whole is factorizable as a product of wave-functions for the system's parts. In this sense, entangled systems are irreducibly holistic, with a common spin (no pun intended) being that entangled particles are not really distinct; hence it is that for one entangled particle to "influence" another does not require faster-than-light (or any) causal connections. (Or so the story goes.) Now return to Strongly emergent phenomena. These are often characterized in terms evocative of failures of separability: a Strongly emergent feature is one which cannot be factored or otherwise reduced to features of its parts. Moreover, the failure of reduction here is one according to which a Strongly emergent feature is holistic, in arising (in this context) under conditions of compositional complexity, with a common spin on such features being that they render the system that has them a unified whole, whose parts are not really distinct. These similarities suggest that on the face of it, Strongly emergent features, like entangled systems, would violate separability, not microcausality.

That said, in my book I argue that entanglement phenomena are not in general clear cases of Strong emergence, since the failure of reduction might be understood as involving Weak emergence from a spatiotemporally extended dependence base. Strong emergence, on my view, involves a fundamentally novel power, which in turn (on my preferred implementation, and as motivated by the case of the weak nuclear interaction; see my 2002 and 2021) involves a novel fundamental interaction which comes into play only at certain levels of compositional complexity. How would this work? Well, whatever is going on here, it won't be a matter of instantaneous causal influences. Rather, on the usual assumption that fundamental interactions are associated with fields, Strong emergence would involve a new fundamental field (or fields) coming into play, which would presumably interact with other fields/interactions in operation, just as standardly posited fields/interactions do. How, exactly, and what theoretical and empirical consequences this would have, would sensitively depend on the nature of the interaction between the standard fields and the new field(s), which as in the case of standard fields/interactions would be an a posteriori, empirical matter. For present purposes it suffices to note that there is no in-principle barrier to understanding Strong emergence in this way,

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[35] It may also be worth noting that, as Weinberg (1997) observes, QFT as standardly formulated is not fully either nonlocal or Lorentz invariant: "there are complications when you have things like mass zero, spin one particles for example; in this case you don't really have a fully Lorentz invariant Hamiltonian density, or even one that is completely local" (7).

and indeed (again, see my discussions of the weak nuclear interaction) there is some historical precedent for doing so.

Fourth, though for the reasons above there's no clear conflict between Strong emergence and QFT, it's worth noting that McLaughlin's claim (following Carroll 2021) that QFT "has been enormously successful in its regime of applicability, and […] human brains fall well within that regime" (288) involves a massive and to my mind unjustified extrapolation. As Carroll himself observes,

> Particle-physics experiments typically examine the interactions of just a few particles at a time, so new physical laws that only kick in for complex agglomerations of particles are not necessarily ruled out by data we currently have (2021: 28).

In that case, though, why think that "particles obey the same equations whether they are inside a rock or inside a human brain" (27), contra applications of Strong emergence to mental phenomena such as (in my book) libertarian free will? Here Carroll appeals to the status of QFT as an effective theory targeting low-energy states, which can be interpreted as collections of interacting particles. Insofar as human beings, like rocks, can (under decomposition) be thought of as such collections, they fall in the regime of applicability of QFT. But the true measure of a theory's "applicability" is predictability, not the fact that, as Carroll puts it, the theory "is meant to be accurate" (18) for phenomena in some or other energy regime. And QFT provides no predictive basis for any human behaviour, unlike the remarkably successful predictions we make through understanding our own and others' mental states. On the face of it, then, McLaughlin's extrapolation, like Carroll's, requires assuming that there are no new fundamental configurational interactions or laws—that, as a synchronic variation on Hume's problem of induction, the physical laws of nature "will continue the same".[36] But like Hume's problem, that assumption builds in what the argument from QFT is supposed to show.

For the various reasons above, I conclude that attention to QFT poses no in-principle difficulty for Strong emergence. But no doubt there is more to say here, and I thank McLaughlin (and Carroll) for raising this important question to salience.

8. Replies to Paolini Paoletti

In his contribution, Paolini Paoletti raises two questions pertaining to the metaphysics of properties, as potentially relevant to my schema for Weak metaphysical emergence. The first question presupposes (correctly, in my view) that in general,

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[36] Carroll also says that "if there are additional particles and forces, they interact too weakly with the known fields to exert any influence on human behavior; otherwise they would have already been detected in experiments" (2021: 18). But again, as Carroll notes, the experiments that have been so far conducted are limited to examining "the interactions of just a few particles at a time" (28), far below the complexity at which, e.g., Strongly emergent mental features are supposed to exist or be instantiated. To be sure, if Strong emergence involves the coming into play of a new fundamental interaction, then once such an interaction is on the scene it could (in principle) have theoretical or empirical consequences for interactions involving systems at lower levels of complexity; but whether this would be the case would be an empirical matter.

not every proper subset of powers associated with a given physical feature P is associated with a Weakly emergent feature. In that case, one can ask:

> (1) What makes it the case that a given proper subset of powers associated with a given lower-level physical feature is associated with a Weakly emergent feature?[37]

The second question presupposes that features can be individuated in a way independently of their powers. In that case, one can ask:

> (2) What makes it the case that a given feature S is associated, with at least nomological necessity, with a given causal profile?

Paolini Paoletti considers certain candidate answers to these questions, and finds them wanting. He then advances essence-based answers to these questions—but, he maintains, an essence-based approach is in tension with the supposition that "everything whatsoever is physical or fully depends on the physical" (311), such that Weak emergence turns out to be "not so weak", after all.

Now, as Paolini Paoletti notes, I don't aim in my book to answer either question. In re the first question: in my book and elsewhere I take for granted what I call the prima facie appearances of metaphysical emergence in the sciences and in ordinary experience, as coupling dependence with ontological and causal autonomy; and then I argue that in various cases we can make sense of these prima facie appearances—most commonly, as satisfying the conditions in the schema for Weak emergence. In cases of broadly scientific properties, for example: what explains why scientists have posited certain higher-level scientific properties as having certain subsets of powers, as is reflected in these properties' entering into certain special-science laws? I discuss certain broadly empirical motivations which seem to be operative in some cases (upon which I'll expand below), but ultimately I take this to be a question for the (natural and social) scientists. My job, as I see it, is just to show that one can make metaphysical good sense of such posits. And in re the second question: as I further discuss below, this question arises only for those holding certain metaphysical views of features (properties and the like) and powers—in particular, those who think that features can be individuated independently of their powers—in the usual case, via a quiddity or primitive identity, which can then be somehow associated or not associated with certain powers. My own view is that there is no reason to think that features of the sort under discussion in my book are associated with quiddities or any other kind of non-causal aspects, in which case the second question doesn't arise, though I also argue in my book that the viability of the schemas for emergence is neutral on whether features are associated with quiddities.

All this said, one way to read the intended import of Paolini Paoletti's remarks is that if one *does* attend to these questions, one will see that they interestingly bear on how Weak emergence should best be understood, and on whether Weak emergence (properly understood) can provide a satisfactory basis for nonreductive physicalism. So in what follows I start by arguing that answers to the first question are plausibly both diverse and empirical, as are answers to the second question as it arises for those accepting quiddities or other non-causal aspects of properties. I'll then follow up by offering reasons to reject a thesis that enters into Paolini Paoletti's critical assessment of certain strategies for answering his

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[37] I phrase this and the second question in terms of "what makes it the case" that P as opposed to why P, in order to sidestep cases where $\neg P$.

questions—namely, Sider's principle of 'Purity' (see Sider 2011: 126–132), according to which the constituents of fundamental facts must themselves be fundamental. Finally, I raise some concerns with Paolini Paoletti's positive "essence-based" answers to the questions, and relatedly, with his claim that if (as on his preferred answers), a higher-level feature and its causal role are in some sense mutually essentially dependent, this poses a problem for physicalism understood as requiring that "everything […] fully depends on the physical" (311).

To start, then: what makes it the case that a given proper subset of lower-level physical powers is associated with a higher-level Weakly emergent feature? This is a question of general interest, whatever one's metaphysics of properties, at least for those who accept that there is or may be Weak emergence. In my book I discuss some of the considerations motivating scientific posits of certain higher-level features having certain causal profiles. One common answer, which I discuss in Ch. 3 in presenting my DOF-based approach to Weak emergence, adverts to there being certain conditions or associated constraints present at the lower level, which serve to eliminate certain microphysical degrees of freedom as required for characterizing the law-governed properties and behaviour of the higher-level feature (which elimination in DOF in turn operates to eliminate certain powers as had by the feature). A different but related consideration, which I discuss in Ch. 5 in motivating the claim that certain complex systems are Weakly emergent, adverts to the suitability for a given complex system to be modeled by the Renormalization Group Method, which in turn reflects that the system ceases to have a preferred length scale—which again serves to eliminate certain lower-level physical DOF and associated powers. So here we have one sort of broadly (lower-level constraint-based) empirical answer to the first question, which Paolini Paoletti considers under the heading of my 'physicalistic solution,' and which he takes to be successful—in particular, "fully compatible with all versions of physicalism" (308), as far as it goes.

As Paolini Paoletti observes, however, my DOF-based account is only presented as a sufficient implementation of the schema for Weak emergence, and so won't work by way of a general answer to his questions; and indeed, as I clarify in my reply to Emery (this volume), other cases of Weak emergence are not clearly ones involving an elimination in DOF; so in these other cases a different answer to the first question might be operative. For a determinable-based implementation of Weak emergence of the sort that seems promising as applied to perceptual mental states, answering the first question would involve exploring why a given determinate has the determinables it does, which would require (among other things) attention to the determination dimensions of the determinate (see Funkhouser 2006). For a functional realization-based implementation of Weak emergence of the sort that seems promising as applied to artifactual features, answering the first question would involve exploring why certain functional roles are salient in our social economy. So here we have different sorts of answers to the first question, but so far as I can tell, these will also be broadly empirical, in depending on complex, broadly contingent facts. As such, even granting the general interest of the first question, I don't see any reason to think that it will have a single or unified answer, much less a single or unified metaphysical answer, of the sort that Paolini Paoletti appears to be seeking.

What about the second question, of what makes it the case that a given feature *S* is associated, with at least nomological necessity, with a given causal profile? Again, it seems to me that this question arises only for those who think that

features can be individuated independently of their powers via quiddities or primitive identities. Paolini Paoletti seems to take such a view for granted in his attempt to answer this question; hence, e.g., in considering whether the connection of a given causal profile to a given property is primitive, he says, "To make sense of this situation from an ontological standpoint, we may hold that there is some irreducible relation R that links S (and only S) with its causal role (and only with it)" (306). He rejects this primitivist answer, for reasons I'll discuss down the line, but the terms of the solution, like the question itself, presuppose that one may refer to a feature in some way independent of its powers—which those rejecting quiddities or the like will deny. Paolini Paoletti suggests that even someone not endorsing quiddities will have to answer a version of the second question. Hence he says of a non-quiddistic view on which properties are mere bundles of token powers that, "one would still need to explain why only certain bundles of token powers (and not others) seem to 'give rise to' or 'be legitimately describable as' token features" (308). But first, one may reject quiddities without embracing a bundle theory (which on the face of it reifies powers in a way that I would resist); one may rather simply think of properties in what I think of as metaphysically adverbial terms, as ways things are.

In any case, the (second) question as directed at the non-quidditist of whatever variety isn't the same as that directed at the quidditist. The question for the non-quidditist can be understood in two ways, depending on whether it is asked against a backdrop assumption of there being lower-level physical features associated with specific causal profiles. If so, then the question collapses into the first question—i.e., what makes it the case that a given subset of physical powers corresponds to a genuine feature? If not—if the question is more generally asking which collections of powers or "ways things are" correspond to genuine properties—the question collapses into the question "Which properties exist?" That's an interesting question, to which whole fields are devoted—but not one that any individual metaphysician has the burden of answering.

Putting my own inclinations aside, it seems to me that proponents of quidditistic accounts of properties typically suppose that the answer to Paolini Paoletti's second question is an empirical matter, even if they disagree over details. Hence, for example, Lewis (1986) supposes that what powers are associated with which (intrinsic, categorical) properties is a matter of the distribution of those properties in the Humean mosaic, which metaphysically contingent distribution determines the laws of nature at the world; and Armstrong (1983) supposes that what powers are associated with which universals is a matter of which metaphysically contingent relations of nomological necessitation hold at the world. Either way, answers to Paolini Paoletti's second question will be both diverse (depending on further commitments of the individual quidditist) and ultimately advert to certain contingent empirical facts.

I want to turn now to a thesis that shows up in Paolini Paoletti's assessment of a primitivist response to the first and second questions. Focusing on a specific instance of the first question, he says "suppose that we claim that it is a primitive and inexplicable fact of the matter that the proper subset made of $p1$, $p2$ and $p3$ (i.e., the causal role of S) is the only one that is associated with a higher-level token feature" (305). He goes on:

> [T]hat R holds between S and its causal role is an irreducible fact of the matter. Thus, it is a fundamental fact. Moreover, this fact constitutively includes a non-

physical token feature such as S. Thus, there are fundamental facts with non-physical token features such as S. The constituents of fundamental facts are fundamental [following Sider 2011]. Therefore, non-physical token features such as S are fundamental. This conclusion may be hard to swallow for physicalists. (306)

Clearly it would be problematic for physicalists were a given higher-level feature, that was supposed to be Weakly emergent and so (though physically acceptable) not identical to any physical feature, turned out to be fundamental; for physicalists of any variety maintain that lower-level physical goings-on are the only fundamenta there are. Now, as above, I don't think there's any pressure here to embrace primitivism about the first or second questions, since each admits of diverse, broadly empirical answers. That said, Paolini Paoletti's remarks offer me an opportunity[38] to rail against Sider's purity principle (for short: 'Purity')—again, according to which the constituents of fundamental facts must themselves be fundamental.

In brief: I see no reason to accept Purity, and on the contrary good reason not to do so. For the fundamental goings-on—whether these be facts, states of affairs, or some other constituents of reality—are (if nothing else) required to serve as a suitable basis for all of reality, including any non-fundamenta there might be. Everyone agrees on this much, whatever the further details of their preferred account of what makes it the case that some goings-on at a world are fundamental at that world.[39] Hence it is that characterizations of fundamentality often start with the familiar "All God had to do" heuristic, according to which the fundamental goings-on are all God had to create in order to create the world as a whole. But if the world as a whole flows, one way or another, from just the fundamenta, then far from supposing that the fundamenta cannot contain or encode reference to non-fundamenta, it seems on the contrary that the fundamenta must contain or encode reference to non-fundamenta, for otherwise it is opaque how they could bring the non-fundamenta in their wake. Hence Purity is false. A better characterization of fundamental facts, it seems to me, is one according to which a fundamental fact must contain at least one fundamental entity or feature as a constituent; but that's compatible with fundamental facts' containing non-fundamenta as well. In any case, given that Purity is (to my mind: clearly) false, Paolini Paoletti's rejection of primitivist answers to his questions will have to rely on considerations (e.g., parsimony concerns of the sort he discusses) other than their leading to a supposed violation of Purity.

I now want to move on to Paolini Paoletti's preferred essentialist approach to his two questions. He maintains:

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[38] Or another opportunity: see Wilson 2018 for an initial salvo.

[39] Among the usual suspects here are independence-based accounts (what makes it the case that some goings-on are fundamental is that they are independent of all else; see Schaffer 2009, Bennett 2017), complete minimal-basis accounts (what makes it the case that some goings-on are fundamental is that they are part of a minimal collection of goings-on which serve as a basis for all else; see Tahko 2018), and primitivist accounts (what makes it the case that some goings-on are fundamental is a primitive matter, not metaphysically analyzable in any other terms—a view which is, by the way, compatible with it being necessary or even essential to the fundamenta at a world that they enter into a basis for all else at the world; see Fine 2001, Wilson 2014 and forthcoming).

> [T]he best way to answer questions (1) and (2) consists in embracing something akin to 'grounding categoricalism,' i.e., the doctrine according to which the causal roles of categorical properties are somehow grounded on those very properties (see, among others, Tugby 2012, 2020, 2022, Yates 2018, Kimpton-Nye 2021, Paoletti 2021). In Paoletti (2021), I have defended the following form of grounding categoricalism: by virtue of its own essence, the causal role C of a categorical property P (i) is the causative role of P, so that it essentially depends (also) on P, (ii) it depends for its origins on P (i.e., it starts to exist as a causal role thanks to P or thanks to the instantiation of P) and (iii) it depends for its continuing to exist (also) on P (i.e., it continues to exist also or only thanks to P or to the instantiation of P). This entails that, as a matter of necessity, the existence of C implies the existence of P: necessarily, C cannot exist without P. And it also entails that, as a matter of necessity, C is the causal role of P and of no other property distinct from P. (308–309)

Here by the "essence" of an entity, Paolini Paoletti means "what that entity non-derivatively is (or could be) in all possible circumstances" (309).

In what follows I'll register certain concerns about an essence-based approach to the questions at issue, and with Paolini Paoletti's claim that such an approach has substantive implications for our understanding of physicalism, and more specifically, of Weak emergence.

First, Paolini Paoletti claims that grounding categoricalism provides attractive answers to the questions he has posed, but I don't see that this is so. Taking properties to be essentially such as to have or be otherwise associated with certain causal roles, which as it happens are comprised of a specific proper subset of lower-level physical powers (per the schema for Weak emergence), certainly provides a mechanism whereby a property and its causal profile go hand in hand, but it doesn't illuminate why (as regards the first question) only certain subsets of lower-level powers are associated with higher-level Weakly emergent properties, or why (as regards the second) a given property is essentially such to have *these* powers, either as a matter of nomological or metaphysical necessity. Again, I'm inclined to think that these questions admit of empirical answers, but Paolini Paoletti seemed to want more—namely, some metaphysical account of why certain collections of lower-level powers, but not others, are associated with some or other feature (the first question), and moreover with a specific feature (the second question). I don't see how grounding categorialism provides such an account, since that causal profiles are essentially tied to properties doesn't tell you what causal profiles and associated properties there are. Rather, grounding categoricalism introduces a slew of new questions, including: which essences are there? and why is a given essence associated with this causal role in this world (worse: at this time) and that causal role in that world (that time)?

If the answers to these questions turn out to be "it's primitive", then Paolini Paoletti's (remaining) concerns with primitivist answers to his question attach also to his account. Now, Paolini Paoletti claims that with his essence-based solution, "we avoid introducing primitive and sui generis connections" (310) between features and causal profiles, but to my mind an appeal to causal profiles as "grounded" in essences just pushes, and indeed multiplies, the primitivist bump(s) in the rug. Paolini Paoletti asserts that the grounding connections are not primitive, since "internal", but even granting that internal relations do not introduce primitive posits, the claim that the relation between essences and causal profiles

is internal doesn't establish this much; since no handle on the relation at issue has been provided sufficient unto showing that the relation is in fact internal.[40]

These considerations provide, in my view, good reason to stick with the usual array of empirical considerations offered by scientists and philosophers as motivating there being these special science features and associated powers/laws, and not others, which methodological strategy provides a generally explanatory and comparatively parsimonious basis for answering Paolini Paoletti's questions (to the extent that one feels pressure to do so, as a consequence of one's independent commitments---e.g., to a quidditistic conception of properties). Here it is also worth noting that one can deny Paolini Paoletti's claim that quiddities are motivated as answering his questions, since as previously discussed, there are available broadly empirical answers to the first question, and the second question doesn't arise unless one posits something like quiddities—in which case a purported need to answer his second question doesn't provide independent reason to posit quiddities.

Second and finally, even if it turns out that properties and their powers are essentially mutually dependent, I don't see that there is a deep problem for physicalism here. Physicalism is the view that all broadly scientific goings-on are "nothing over and above" lower-level physical goings-on, in the way that reductive versions of physicalism (appealing to identity) or non-reductive versions of physicalism (appealing to functional or other forms of realization, the key features of which are encoded in the schema for Weak emergence) aim to capture. It isn't any part of the physicalist project to maintain that mathematical or metaphysical features—e.g., the property of being prime, the relation between a universal and its instantiation, or (if such there be) the relation between a feature and its causal profile—are in any way nothing over and above or completely dependent on lower-level physical goings-on. So even if one is inclined to follow Paolini Paoletti in taking an essence-based approach to the questions he has raised, this in itself poses no tension with physicalism, or so it seems to me.

<h2 style="text-align:center">References</h2>

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[40] In addition, Paolini Paoletti appeals to diverse, but unspecified, dependence relations in order to accommodate a purported "circle of dependence" between features and profiles, in which case his approach appears to involve (in addition to its being primitive what essences of features there are, and primitive that certain causal profiles depend on such essences) a third primitive component, tracking that the features at issue depend on the associated profiles.

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