Good VIBES only

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Abstract

How to articulate the common ontological commitments of symmetry-related models of physical theories? This is a central (perhaps *the* central) question in the philosophical literature on symmetry transformations in physics; recently, Dewar (2019) has proposed a strategy for answering this question which goes by the name of 'external sophistication'. And yet: this strategy has been accused of being hopelessly obscure by, among others, Martens and Read (2020). In this article, I demonstrate that not all cases of external sophistication are subject to this charge—for reasons which will become clear, the cases for which this is not so give us what I'll call 'good VIBES'. Having established this, I then go on to consider good VIBES in the context of the analysis of hidden symmetries, in dialogue with recent work on that topic by Bielińska and Jacobs (2024).

"With the right vibes and the right people, it's easy to create something magical." — Dinah Jane

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1 Introduction to VIBES

Consider the symmetry transformations of a given physical theory which preserve empirical content. (I don't commit here to an 'epistemic' approach to symmetry transformations *à la* Dasgupta (2016), which would have the above restriction be part of the *definition* of a symmetry transformation; this restriction is perfectly compatible with what Dasgupta calls 'formal' and 'ontic' definitions of symmetries, the latter of which in fact I prefer.[1]) How best to articulate the common ontology of models of a given theory related by symmetry transformations of this kind?

Since the seminal work of Dewar (2019), it has been acknowledged widely in the philosophical literature on symmetry transformations in physics that three options are available here:

Reduction: Map orbits of symmetry-related models of the original theory to unique models of some new, 'symmetry-reduced' theory.

External sophistication: Treat the symmetry-related models of the original theory 'as if' they are isomorphic. Then, apply anti-haecceitism/anti-quidditism in one's interpretation of those models in order to justify their representing the same physical states of affairs.

Internal sophistication: Reformulate the original theory mathematically in order to 'forget' about structure such that symmetries now act as isomorphisms.[2] Then, apply anti-haecceitism/anti-quidditism in one's interpretation of those models in order to justify their representing the same physical states of affairs.

For more on this threefold distinction, see Martens and Read (2020),[3] in particular on the second interpretative step of both external and internal sophistication, which in-

[1]See Read and Møller-Nielsen (2020b). That article also discusses the difficulties in cashing out the 'empirical content' of a model of a theory, as does Dasgupta (2016); I won't consider this issue further here.

[2]What exactly do authors in this literature mean when they speak of models' being 'isomorphic'? They mean in the sense of Bourbaki (2004). For an explicit presentation of this notion of isomorphism in the abstract, see Corry (2004, p. 319). For me, this will amount to all of the models' objects being related by the push-forward (or pull-back) under some diffeomorphism—see Martens and Read (2020, §3.2) for an explicit presentations of when models are and are not isomorphic in this sense. I'm grateful to Joanna Luc for suggesting that I mention Bourbakai's notion of isomorphism here.

[3]The distinction is also discussed at length by Jacobs (2021).

volves anti-haecceitism/anti-quidditism. (I'll come back to this second interpretative step in §3 below.)[4]

Now, one would be perfectly within one's rights to find puzzling, and perhaps 'metaphysically unperspicuous', external sophistication as presented above.[5] In my view, following March (2024b), the correct way to understand this approach is in terms of inserting 'extra' morphisms into a theory understood categorically. The idea of a categorical understanding of a theory (on which see e.g. Weatherall (2016)) is that one treats the objects in the category as being the models of the theory, and morphisms in the category as maps relating models regarded as being 'equivalent' (so, loosely, the morphisms in the category have to do with how one interprets the theory). Typically—but not necessarily!—these morphisms will relate models which are themselves isomorphic (*qua* mathematical objects). But they need not; one might have more or fewer morphisms in the category than the number of isomorphisms between the objects of the category. When there are *too many* morphisms, one has a case in which models of the theory are regarded 'as if' they are isomorphic, despite their not actually being so (roughly, this tracks a violation of Earman's (1989) symmetry principle SP1 in the sense that the models have 'too much' structure[6]); when there are *too few* morphisms, one has a case in which models of a theory which should be regarded as being equivalent (by the standards of mathematical equivalence—see Weatherall (2018)) are in fact not so regarded (roughly, this tracks a violation of Earman's (1989) symmetry principle SP2

[4]Here is a good place to clarify that I don't think it is correct to regard 'reduced' and 'sophisticated' (whether internally or externally) as being *intrinsic* properties of theories. Instead, it is better to understand 'reduction' and 'sophistication' as moves that one makes to reformulate a theory with respect to a class of its symmetry-related models.

[5]Again, see Martens and Read (2020) for discussion; see also Møller-Nielsen (2017) and Read and Møller-Nielsen (2020a). The term 'metaphysically unperspicuous' is ubiquitous in this literature—but it's far from perspicuous(!) what it means. Read (2024) cashes the notion out in terms of what would count, for a particular theoriser, as a *psychologically satisfying* metaphysical picture. Naturally, this will vary from individual to individual depending upon their predilections, philosophical commitments, etc.—but the thought in the context of external sophistication is that simply *declaring* to be isomorphic two non-isomorphic models of a given theory (when they might in fact be very different indeed) leaves significantly under-specified what the *true* ontological commitments of those models are supposed to be, and *ipso facto* is unsatisfying and unperspicuous. Related to this, Chen (2024a, p. 18) puts the non-perspicuity worry nicely, when she writes that, on external sophistication, "we would have to embrace a fundamental characterization of reality through the structural relations between models rather than within models, and this seems too bizarre even for structuralists to swallow."

[6]I say 'roughly' because, of course, Earman's symmetry principles were originally expounded in the context of spacetime theories (and the coincidence or otherwise of spacetime and dynamical symmetries). Earman's principles have recently been generalised to 'internal' symmetries by Jacobs (2021). (I'm grateful to an anonymous referee for pushing me to be clear here.)

in the sense that the models have 'too little' structure). When the morphisms in the category coincide with the isomorphisms of the objects in the category, one has the Goldilocks situation of what March (2024a) calls a 'literal' interpretation of the theory.

In brief, then: one sensible and clear way in which one can understand external sophistication is as inserting more morphisms into a category, but this is ambiguous between the above two cases. In the literature up to this point—where the "treat non-isomorphic models 'as if' they are isomorphic" claim is widespread[7]—this strategy is almost exclusively considered in the former case, in which models (now understood as objects in the relevant category) which are themselves *not* isomorphic have morphisms drawn between them. However, it is far from clear that this way of understanding external sophistication affords it the resources to evade the original metaphysical unperspicuity charge. What does it mean to regard non-isomorphic models 'as if' they are isomorphic? Is this anything more than a "flat-out contradiction", as Martens and Read (2020, p. 26) worry?[8]

For this reason one could, somewhat pejoratively, accuse external sophistication of being 'vibes-based' rather than 'math-based'.[9] In particular, the notion of isomorphism involved in external sophistication seems non-standardly 'vibes-based'. For short, I'll call external sophistication which relies on this (somewhat obscure and—to repeat—non-standard) notion of isomorphism 'Vibes-Isomorphism Based External Sophistication', or VIBES.[10]

And yet: when one considers certain recent cases which have been discussed in the philosophy of physics, one sees clearly that not all VIBES are bad. To take one concrete and recent example, consider the discussion of different formulations of the teleparallel equivalent of general relativity (TEGR) by March et al. (2025). In this case, the authors

[7] See e.g. Dewar (2019) and Martens and Read (2020).

[8] In response to this charge from Martens and Read (2020), Jacobs (2022a) suggests that sophistication *can* in fact be had on the cheap, and in a non-contradictory way, by reconstructing the models in one's theory such that they are now *equivalence classes* of variant objects in the symmetry-related models of the original theory which one was considering. I have three comments to make on this. First: the approach involves reformulating the models, and so does not, as I understand the distinction, count as a case of *external* sophistication. Second: following on from this, taking equivalence classes in this way is in fact compatible with both the strategies of internal sophistication and reduction (see March (2024b)). And third: while not contradictory, I nevertheless regard this approach as being metaphysically unperspicuous (see again March (2024b), and from a somewhat different angle Adlam et al. (2024)—though to be clear Jacobs (2022a) *also* thinks this, albeit for different reasons to those of Martens and Read (2020)).

[9] Internal sophistication, on the other hand, involves mathematical work and so is clearly 'math-based'.

[10] I ask the reader to grant me some grammatical leeway when I talk about VIBES in the remainder of this article!

note that certain physicists treat models of a version of TEGR formulated in terms of a tetrad-spin connection pairs related by local Lorentz transformations as being physically distinct—*despite* these models' being isomorphic, because prinicpal bundle automorphisms include these very local Lorentz transformations. Hence, as March et al. (2025) point out, there is a strong motivation to insert further morphisms into this category, and thereby to apply VIBES.

What cases like this show is that there evidently can be some good VIBES; and in particular, VIBES are *far* less bad when one turns to the second of the cases of external sophistication considered above—i.e., the case in which there are originally *too few* morphisms in the category, and VIBES bring into line the categorical morphisms and mathematical isomorphisms of the category's objects. (Or at least, when the VIBES bring the two into closer harmony—more on this below.) For consider cases in which one externally sophisticates a given theory by inserting more morphisms into its category, so that the resulting morphism-related objects are regarded 'as if' they are isomorphic. And yet, it turns out that those morphisms really did relate isomorphic models to begin with! These are cases of *good VIBES*—where the 'metaphysical unperspicuity' charge does not apply to external sophistication, because external sophistication here just happens to also be a case of internal sophistication!

What this preliminary discussion in fact reveals, then, is that there are three different species of VIBES:

Good VIBES: The insertion of morphisms into a category which brings into closer agreement the categorical morphisms and isomorphisms of the objects in the category related by those morphisms.

Bad VIBES: The insertion of morphisms into a category which brings into diminished agreement the categorical morphisms and isomorphisms of the objects in the category related by those morphisms.

Immaculate VIBES: The insertion of morphisms into a category which brings into *exact agreement* the categorical morphisms and isomorphisms of the objects in the category related by those morphisms.

In addition to using this terminology, I'll sometimes say that one is *killing VIBES* when one removes morphisms in a category which one had occasion to introduce previously—we'll see specific cases below which illustrate exactly what I mean by this.

Having introduced VIBES in this way, I'm now in a position to lay out my goals for this article. My purpose, to be specific, is to explore cases and applications of good VIBES more carefully and more systematically, since good VIBES have received very little attention in the philosophical literature up to this point (and even for March et al. (2025) mentioned above they are not the central focus). In a nutshell, my Credo will be the following:

Good VIBES only.

Consonant with this Credo, I'll in the remainder of this article seek to make good on the following two tasks:

1. To argue that external sophistication is not all bad, because there are cases of good VIBES, in the sense articulated above. (And the best VIBES, of course, are immaculate VIBES.) Thereby, to offer some (partial) *rapprochement* between Dewar (2019) and Martens and Read (2020) on this topic.

2. To expose the particular role that good VIBES have to play in explicating the epistemology of hidden symmetries in physics, building upon recent work on this topic by Bielińska and Jacobs (2024). That is, to put good VIBES to good work.

So far, I've said nothing on (2), so let me do that now. Roughly, the idea of a 'hidden symmetry' of a physical theory as I'll understand it in this article is that there exists a symmetry transformation which is not immediately obvious to physicists, but which is eventually discovered and recognised as a *bona fide* symmetry of the theory.[11] It's my contention that good VIBES offer a very helpful and clear explication of the epistemology of hidden symmetries, and I will explore this idea in detail later in this article.

Now, before I continue, I should make two things clear. The first is that there is an epistemic component to how I understand external sophistication: it isn't just something which happens *for free* when I have isomorphic models, because I might not *know* that those models are isomorphic, and so I might not have inserted the appropriate morphisms into my theory (understood categorically) to denote that I am regarding those models as being equivalent. And even if I *do* know that the models are isomorphic, I might *under certain circumstances* still want to resist regarding the models as being equivalent by inserting morphisms into a category—I'll set this important issue aside for now, but will return to it in §3.

The second point to make clear is this. Suppose that there were some general recipe for moving from an externally sophisticated theory to a suitably reformulated theory

[11] I concur with Bielińska and Jacobs (2024) that offering a *precise* definition of hidden symmetries might be difficult; the above characterisation will suffice for my purposes in this article, although I'll discuss this issue further below.

(whether that be reduced or internally sophisticated). I agree that this would assuage worries about external sophistication to some degree (more on which below). Indeed, there are already some proposals in the literature which look something like this, for example:[12]

- Chen (2024b, §4) proposes what she calls 'natural operator algebraicism' as a means of legitimising external sophistication, by deploying the resources of algebraic fields in order to give an argument to the effect that an alternative theory will always be available once one has externally sophisticated.[13]

- Nguyen et al. (2018) and Teh (2024) propose (albeit in this case without explicitly mentioning external versus internal sophistication—although see Linnemann and Read (2025) for a discussion of this move in that context) to move to formalising the objects of theories in terms of 'moduli stacks', in which (in effect) the morphisms between models in the category are transferred into the models themselves, now understood as category-theoretic objects.

If it is indeed the case that (a) these recipes are always available, and (b) they always yield 'metaphysically perspicuous characterisations' of the ontology of the models under consideration, then I agree that this would in fact help to set external sophistication on solid footing and render it metaphysically above-board, for we would have reassurances that, when we externally sophisticate, an avenue for reformulation is always going to be available. However, since the proposal of Chen (2024b) is (by her own admission) very much a sketch, and since (with Linnemann and Read (2025)) the proposal of Nguyen et al. (2018) and Teh (2024) in terms of moduli stacks is far from obviously yielding something 'metaphysically perspicuous' (insofar as, to repeat, it seems simply to move the morphisms from *between* the models to *within* the models), there remains much (admittedly very interesting) work to be done here.[14] In any case, none of these

[12]In addition to these, there is Jacobs' proposal (see Jacobs (2022a)) which I mentioned in footnote 8.

[13]Here is Chen (2024b, p. 21) summarising her strategy: "To apply this method to physical models, suppose we start with a category of algebraic models with redundant degree of freedom according to a symmetry. We render [symmetry-related models] as isomorphic by adding new morphisms based on this symmetry. Then, we can find out the desired algebraic structure of the new models that are invariant under the symmetries by applying the above method of natural operators." The details of her strategy don't matter for my purposes in this article.

[14]In addition, it is worth pointing out—as noted by both Chen (2024b, p. 24) and Linnemann and Read (2025, §5) for the respective options—that both of these avenues are actually better understood as cases of *reduction* rather than internal sophistication, for they collapse the original classes of morphism-related models to single models.

points detract from what I will say in this article about the fact that there will sometimes be cases of good VIBES and on the relationship between external sophistication and hidden symmetries—so, with that in mind, I'll continue.

With the above, I've in fact by now already introduced all that needs to be said for my purposes in this article on external sophistication (understood categorically) and (specifically) VIBES. So, going forward, the plan is this. In §2, I discuss how good VIBES can shed light on the epistemology of hidden symmetries, thereby making good on task (2) above. In §3, I return to and explore an issue raise above: that sometimes the move to good VIBES might be resisted. In §4, I consider how good VIBES offer a path to (at least partial) reconciliation between Dewar (2019) and Martens and Read (2020), thereby making good on task (1) above.

2 Hidden symmetries and VIBES

Despite the widespread use of the term in modern physics, the notion of a 'hidden symmetry' has only very recently been brought to philosophers' attention, in an insightful article by Bielińska and Jacobs (2024). As mentioned in the previous section, for our purposes we can take a hidden symmetry to be a symmetry transformation which is not immediately obvious to physicists, but which is eventually discovered and recognised as a *bona fide* symmetry of the theory. As I'll understand the notion, then, a symmetry's being hidden is not an intrinsic property of the relevant transformation; rather, its being hidden is a relational property which obtains between a symmetry transformation of a physical theory on the one hand, and the epistemic state of some community on the other.

There are a few points to shore up here before proceeding. First, one might ask: 'Which epistemic community? Can it in fact be a community of one—i.e., an individual?' On these matters, I'm inclined to take a liberal attitude, and respond 'yes' to the second question, in which case one has simply to accept that plenty of even the most well-known symmetries of (say) Newtonian gravitation will be 'hidden' for (say) a child in kindergarten(!) But I'm also inclined to think that generally the *relevant* community to focus on when it comes to making sense of the sociology of discussion of hidden symmetries will (quite naturally) be the community of expert physicists in whatever subfield of physics one is considering.[15] Second: my 'epistemic' understanding of hidden symmetries does not obviously line up with the definitions which one will sometimes find in the physics literature, which are often formal and/or geometrical in nature (for

[15]Roughly, this tracks van Fraassen (1980) on the most salient sense of 'observable' being that which is relative to some epistemic community.

a helpful catalogue of particular proposals from physicists in this regard, see Bielińska and Jacobs (2024, §2)). To this I am inclined to say: (a) so be it, for in any case my proposal for what constitutes a hidden symmetry seems nevertheless to be plausible, one which makes good sense of how theorists often use the term, and one worth studying *per se*. And (b): ultimately, I'm open to adopting a pluralistic approach to the notion of a hidden symmetry, and to conceding that my proposal above is but one interesting option. Third: insofar as they take *inter alia* the above-mentioned formal/geometrical definitions of hidden symmetries as *data*, Bielińska and Jacobs (2024) might not always agree with me about what constitutes a hidden symmetry. But, ultimately, I think that any apparent disagreement here does not run particularly deep, for (I) Bielińska and Jacobs (2024) themselves acknowledge the difficulty of providing a precise and univocal definition of 'hidden symmetry',[16] and (II) as I have already mentioned, I am willing to adopt a pluralistic attitude towards the notion in any case.

With these preliminaries on the table, going forward I will focus my attention on my above-proposed 'epistemic' conception of hidden symmetries. So let's now move on. Very helpfully, Bielińska and Jacobs (2024) survey a number of cases of what are often referred to as 'hidden symmetries' in physics, including (i) the Lenz–Runge symmetry in the Kepler problem,[17] (ii) certain symmetries in the modelling of the hydrogen atom, (iii) likewise for the harmonic oscillator, and (iv) in Kerr black holes. Quite correctly, Bielińska and Jacobs (2024) point out that not all of the above hidden symmetries (i)–(iv) seem to have a role to play in making inferences about ontology on the basis of symmetry transformations—that is, not all seem to be involved in 'symmetry-to-reality' inferences. But, as they identify, the reason for this is often that such hidden symmetry transformations are to be understood as applying to *subsystems*, and cannot straightforwardly be extended beyond that.[18] As such, when one studies the combined system of subsystem-plus-environment, the symmetries have empirical consequences—'direct empirical significance', in the terminology of Greaves and Wallace (2014). This places them outside of the remit of the symmetries in which I declared myself to be interested at the beginning of this article—namely, those which relate (whether by definition or otherwise) empirically equivalent states of affairs (both for subsystems and globally).[19] Having said this, it's not difficult to come up with historical examples of symmetries which, at some time or other, would have counted as 'hidden', yet which do also fall into the category of symmetry transformations in which I am interested here. Take, for ex-

[16] Cf. footnote 11.

[17] First presented in the philosophical literature by Belot (2013), and discussed subsequently by Luc (2022) and Wallace (2022).

[18] The relevant systems are not 'subsystem recursive', in the sense of Wallace (2022).

[19] That said, I make below a few further remarks on hidden symmetries of this kind.

ample, the Trautman gauge symmetry of Newtonian gravity set in Galilean spacetime: simultaneously redefining the affine connection and gravitational field of this theory in specific and compensating ways yields a distinct spacetime model which is nevertheless empirically equivalent to the original model. Plausibly, prior to the work of Trautman (1965), this transformation would have counted as hidden—even though, naturally, it does not now so count![20]

It is here that good VIBES (and in fact not *only* good VIBES, as we'll see) can be put to good work. Suppose that one has some physical theory, but—by dint of studying that theory in a variety of contexts, becoming acquainted with it, etc.—one comes to suspect that there might in fact be some hidden symmetry relating some of the models of this theory. In that case, one might—tentatively—insert more morphisms into the objects of one's category; this, in turn, might motivate one to investigate the models of the theory related by those morphisms. And here there are two cases:

1. After investigation, the models concerned are discovered *not* to be related by a symmetry transformation (however defined—see above). Then, one will (with regret) remove the proposed morphisms; one will kill the VIBES.

2. After investigation, one establishes that the models concerned *are* related by a symmetry transformation (however defined—see above). Then there are two subcases:

    (a) After investigation, one discovers that the models related by the morphisms just introduced are mathematically equivalent (i.e., are isomorphic), even though this might not have been recognised previously. In this case, one has a case of good VIBES (and, in the limiting and ideal case, immaculate VIBES), in the sense that the strategy of external sophistication has in fact brought the morphisms of the category and the isomorphisms of the models closer into line (in the ideal case: perfectly into line).

    (b) After investigation, one realises that the models, while symmetry-related, are *not* isomorphic.[21] This is certainly not a case of good VIBES: it is in fact

[20] For more on the interpretation of Newtonian gravity in light of Trautman gauge symmetry, see e.g. Knox (2014) and Read and Møller-Nielsen (2020a). (Related to my third point of clarification above: given that Bielińska and Jacobs (2024) use the term 'hidden symmetry' in a slightly different way to me, it's not completely obvious that the Trautman gauge symmetry would count as 'hidden' by their lights—I'm grateful to an anonymous referee for pointing this out.)

[21] A classic case of this, recall, is kinematic shifts in Newtonian gravitation set in Newtonian spacetime: see e.g. Read and Møller-Nielsen (2020a).

a case of *bad* VIBES; of 'metaphysically unperspicuous' external sophistication.

Begin with case (1). Suppose one has some suspected hidden symmetry (say, the Lenz–Runge symmetry for the Kepler problem) which one does not appreciate initially is in fact *not* a symmetry in the sense that it does not preserve empirical content (at least for subsystem-plus-environment totalities, as discussed above—so for the case of the Lenz–Runge symmetry one will come to realise that this is not a global symmetry). When one realises this, one will kill the VIBES: too bad for those morphisms.[22]

In this classification of possibilities, case (2) is more interesting and involved and I will now spend considerably more time discussing it. Beginning with case (2a), this is that considered by March et al. (2025) as already mentioned above: on certain approaches to TEGR, theorists do not regard as equivalent models which in fact *are already* isomorphic; inserting the extra morphisms in the category then brings the two into line, and is accordingly a case of good VIBES (perhaps even immaculate VIBES, although this might not be known to the theorists at the time that the extra morhpisms are inserted into the category). But this is not so for case (2b), in which although a symmetry of the theory has been identified correctly, the morphisms in the category do not relate isomorphic models. Case (2b), then, is what March (2024a) calls a case of a 'non-literal' interpretation; here, one is motivated (on Occamist grounds) to develop some new theory (an *internally* sophisticated theory, in the sense of Dewar (2019)[23]) by 'forgetting' structure such that the morphisms relate models which in fact now *are* isomorphic.[24]

At this point, it is helpful to bring in an adjacent debate in the philosophy of symmetries: that between 'interpretationalism' and 'motivationalism' about symmetries. According to the coarse-grained initial presentation of these two positions provided by Møller-Nielsen (2017) and Read and Møller-Nielsen (2020a), intepretationalism has it that symmetry-related models can be regarded *ab initio* as representing the same physical state of affairs (even in the absence of a metaphysically perspicuous characterisation of their common ontology), whereas motivationalism has it that one is at best *motivated* to find a metaphysically perspicuous characterisation of their common ontology. Now, taking it (as I have done above) that morphisms in a category relate models which are to be interpreted as being equivalent, in case (2b) the interpretationalist would have it

[22] In some cases, this might have to do with the realisation that Killing fields are not global. There, one could speak of Killing the VIBES.

[23] Recall the tripartite classification of options presented at the beginning of this article.

[24] Or one could seek a reduced theory, in line with e.g. the proposal from Chen (2024b) which I mentioned above.

that these models can be regarded *ab initio* as representing the same physical state of affairs, although one might still be motivated (in accordance with what I've said above) to move to a new theory in which the VIBES are immaculate. On the other hand, the motivationalist would have it that it was never really legitimate to insert these morphisms to begin with, in the absence of such an alternative theory in terms of which the original theory can be interpreted non-literally; they will kill the VIBES until such a theory is found. Indeed, in case (2a) the motivationalist will likewise maintain that it is not legitimate to insert morphisms into the category until its discovered that the objects to be related by those morphisms are in fact isomorphic; only then (and indeed, only then to the extent that this motivationalist is willing to help themselves to anti-haecceitism/anti-quidditism—Dasgupta (2016) is an example of a motivationalist who is not (see Read and Møller-Nielsen (2020b))) will they regard this move as being legitimate.

Recent work by Luc (2023) helps to nuance this picture somewhat. Very helpfully, Luc (2023, p. 16) distinguishes between the following three questions which are tied up in the interpretationalism/motivationalism debate:

> 1. What should our initial reaction towards symmetry-related models of [theory] T be—should we regard them as physically equivalent or as physically inequivalent?
> 2. Should we look for a perspicuous account of the ontology shared by symmetry-related models of T?
> 3. How should we update our interpretation of symmetry-related models of T depending on the outcomes of the research mentioned in question (2)?

Luc (2023, pp. 19–20) then goes on to identify a more subtle position in the interpretationalism/motivationalism debate which she calls 'concessive interpretationalism with motivation', which answers these three questions in the following way:

> 1. We should initially interpret symmetry-related models of T as physically equivalent.
> 2. Yes.
> 3. If we find such an account, we should retain our initial interpretation, whereas if despite lots of effort we do not succeed in finding it, we should change our interpretation and begin to regard symmetry-related models of T as physically inequivalent.

On this position—which indeed strikes me as one of the more reasonable and compelling positions which one could occupy in these debates—inserting the extra morphisms in (2b) is justified even as one continues to search for a theory in which the VIBES are immaculate (in the sense that one has 'forgotten' about structure in the models such that model isomorphisms now coincide with categorical morphisms); eventually, however, one's lack of ability to find such a theory might lead one to—with regret—kill the VIBES.[25]

Let's step back. What all of this highlights is that there is in fact a twofold tentativeness in the insertion of morphisms into a category when thinking about hidden symmetries. The first point of tentativeness has to do with one's deliberations about whether to insert extra morphisms into the category associated with some theory to begin with, when one suspects that the theory contains a hidden symmetry; subsequent investigation might or might not in fact vindicate one's initial suspicion that the now-morphism-related models are symmetry-related. If they are *not* symmetry-related, then one finds oneself in case (1), and one will accordingly kill the VIBES. If, on the other hand, the now-morphism-related models *are* symmetry-related, then one finds oneself in case (2). Then, if one convinces oneself that these models are isomorphic (as in the case—recall again—of the teleparallel equivalent of general relativity considered by March et al. (2025)), then one has good VIBES, and there is nothing more to do with respect to these symmetries.[26] This is case (2a). However, on the other hand, if those now-morphism-related models are *not* isomorphic (which is case (2b)), then one arrives at the second point of tentativeness: can one identify or construct some new theory which is 'metaphysically perspicuous', in the sense that the isomorphisms of its models coincide with its categorical morphisms? If, after sustained work, one cannot do this, then—*per* concessive interpretationalism with motivation—one's credence in these models *in fact* representing the same physical state of affairs, and so in its having

[25] This is to be contrasted with Luc's 'graded interpretationalism with motivation', which modifies the answer to (3) to read: "If we find such an account, we should retain our initial interpretation, whereas if despite lots of effort we do not succeed in finding it, we should still retain our initial interpretation as more plausible than its opposite, but we should significantly decrease our confidence about this interpretation" (Luc 2023, p. 20). In my terminology, graded interpretationalism with motivation is not open to killing the VIBES, despite potentially substantial evidence against the availability of a metaphysically perspicuous explication of the common ontology of the symmetry-related models under consideration. Evidently, this has the potential to lead one down epistemologically bad roads—maintaining one's initial set of beliefs despite substantial countervailing evidence—and for this reason I consider concessive interpretationalism with motivation to be superior to graded interpretationalism with motivation. (That said, there are perhaps interesting connections to be made here with the notion of 'gritty belief' in epistemology—see Paul and Morton (2018).)

[26] Except, perhaps, to apply anti-haecceitism/anti-quidditism—see §1 and in addition §3 below.

been appropriate to insert these morphisms to begin with, might diminish; in that case, one might eventually kill the VIBES. But on the other hand, one might in fact find such a theory (say by doing the hard mathematical work of internally sophisticating—Dewar (2019) presents several examples of this, which are discussed further by Martens and Read (2020)—or by following the strategy of e.g. Chen (2024b) to which I pointed above), in which case one's insertion of those morphisms is vindicated, and one might either (i) continue to work with the models of the original theory but interpret them non-literally (again in the sense of March (2024a)), or (ii) (likely better) move to using that very new theory, which *is* literally interpreted and which is such that the isomorphisms of its models coincide with its categorical morphisms.

By now, I hope to have made compelling the following overarching point: although good VIBES might *prima facie* seem pointless—a mere philosophical curiosity (for who *wouldn't* interpret isomorphic models of a given theory as representing the same physical state of affairs?)—they in fact have a substantially more significant role to play in interpreting physical theories than one might have thought. First, because exactly this situation does in fact play out in practice (in e.g. the cases considered by March et al. (2025)). And second, because VIBES of all stripes—good, bad, and immaculate—seem to be extremely useful (and perhaps even essential) in properly explicating the epistemology of hidden symmetries.

3 Not feeling the VIBES?

Although in §1 I presented my 'Good VIBES only' Credo, I also alluded to the fact that the situation is sometimes complicated by the fact that, at least on some occasions, one might not want to regard isomorphic models of some physical theory as representing the same physical states of affairs—which might in turn lead one to resist inserting the relevant morphisms into the category associated with that theory. To illustrate this, consider e.g. the case made by Belot (2018) that one should regard certain isomorphic models of general relativity which differ by boundary diffeomorphisms as being physically *distinct*, on pains of e.g. not being able to define certain conserved quantities.[27] In such cases, one isn't even motivated to insert morphisms in the category and secure immaculate VIBES—one is not, one might say, *feeling the VIBES*.[28] I accept the existence of such cases—but I also don't take them to detract from any of the points which I have made above in this article. And in any case there are some subtle issues here, to which I'll return at the end of this section.

[27] Issues to do with boundaries are also considered by Wolf and Read (2023) in the context of TEGR.
[28] Cf. Luc (2022) and Read (2023, ch. 2).

Here's another case where something like this might happen, i.e. where one might not feel the VIBES. Consider first a version of Newtonian gravitation theory in which the gravitational constant G is held fixed across all models (as insisted upon by Martens (2020, p. 12)—this, as Jacobs (2022b) points out (albeit not in this terminology), is akin to introducing a 'fixed field' in the terminology of Pooley (2016) and Read (2023, ch. 3)). Now consider scalings of the mass parameters in such a theory: it's noted by Martens (2020, 2021) that absolutists about mass are often quidditists about mass (this, indeed, is Martens' own preferred position), in which case (e.g.) doubled-mass worlds are isomorphic but are not to be regarded as being physically equivalent; Martens avers that this quidditism is necessary in order for forces to 'latch onto' the correct mass magnitudes (cf. Jacobs (2022b)), and as such he seems not to feel the VIBES in this case.

Again, I think that we should be open to the existence of cases like this, but that they don't undermine the points which I want to make in this article. But it's worth dwelling on the second case a little longer, because there are some interesting subtleties here. The first thing to say is that since (at least when we hold G fixed) active mass scalings are *not* symmetries of the laws of Newtonian gravitation (because they do not preserve the laws—see Jacobs (2022a)), it's not obvious that this case is in the end relevant for our discussions anyway (because we were always focussed on transformations which *are* symmetries). More relevant would be what what Jacobs (2022a, p. 807) dubs 'inclusive active mass scalings', which also involve an appropriate transformation of G—in this case, models related by these transformations preserve the dynamics and are empirically equivalent and isomorphic and as such (Jacobs (2022a) avers—and I agree) count as symmetries of this version of Newtonian gravitation theory (in which, to repeat, the gravitational constant G is no longer fixed identically in all models of the theory). How do things play out with respect to mass scalings in this case? In this case, one can strive for good VIBES and include morphisms between the models of the theory related by these transformations; as Jacobs (2022a, p. 822) makes clear, scaling G also obviates the need to introduce quiddities (as Martens (2020) had it—see above).[29] On this way of understanding Newtonian gravitation theory, then, one will likely be more inclined to feel the VIBES.

I want to make one final point on this latter case. Strictly speaking, inserting these morphisms denotes that these models have the same *representational capacities* (to use the terminology of Weatherall (2018) and Fletcher (2020); cf. Pooley and Read (2025));

[29]That said, there might remain other reasons which motivate one to resist anti-quidditism. For example, with e.g. Dasgupta (2011), one might regard anti-quidditism as being an obscure metaphysical thesis. Or alternatively, one might think, with Maudlin (1993), that (say) indexical arguments can be adduced to the effect that a plurality of such models presents no epistemological challenge (i.e., Leibniz shift problem) to begin with (for further discussion of this second case, see Cheng and Read (2021)).

in itself, it does not mean that these models *must* be regarded as representing the same physical states of affairs—indeed, in principle, these models still represent distinct worlds which differ merely quidditistically, leading thereby (again, as Jacobs (2022a) notes) to a kind of indeterminism very familiar from e.g. the hole argument. Now, if one is a quidditist about this version of Newtonian gravitation theory, then one is indeed confronted with indeterminism of the hole argument kind. But if, with Jacobs, one then takes the further step of adopting an anti-quidditist approach, then (just as with being an anti-haecceitist in the case of the hole argument) there is no indeterminism here: this, indeed, is why the second step of external/internal sophistication was included in the first place (recall my discussion of this from §1). Note that—again, just as in the case of the hole argument (and *pace* Weatherall (2018))—all of these issues play out even *after* one has secured good VIBES by inserting morphisms between isomorphic models in the category.

4 Coda: good VIBES only

External sophistication, and in particular VIBES, has had a rough ride in recent years; it has, for example, been labelled "sophistry about symmetries" by Martens and Read (2020). But what I hope to have demonstrated in this article is that not all VIBES are bad. In fact, VIBES are only bad—'metaphysically unperspicuous'—when they involve treating non-isomorphic models 'as if' they are isomorphic, by inserting further morphisms into the category associated with some theory than are warranted by the isomorphisms of the models of that theory. But VIBES are good when they restore morphisms *which should have been there in the first place*—when they bring model isomorphisms and categorical morphisms closer into line.

The studies undertaken by e.g. March et al. (2025) already reveal this to be more than merely an abstract point. But the case of hidden symmetries makes particularly clear the positive interpretative and philosophical role that good VIBES have to play—when one makes tentative insertions of morphisms when one conjectures the existence of hidden symmetries. (These tentative insertions *might* lead to bad VIBES, as discussed above in case (2b), but mathematical work *à la* internal sophistication can then bring model isomorphisms and categorical morphisms into line.)

All in all, my investigations here thereby offer a partial (but not complete, since of course they apply only to the case in which the symmetry-related models under consideration are in fact isomorphic) *rapprochement* between Dewar (2019) and Martens and Read (2020): external sophistication can be acceptable when it offers good VIBES (and is optimal when it offers immaculate VIBES); not all VIBES are in fact bad. On the basis of this reconciliation, I have good vibes about the prospects for future fruitful dialogue between all parties in the philosophy of symmetries going forward!

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