

# Four Grades of Modal Naturalism

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**Abstract:** How, if at all, can scientific progress improve our view of the modal facts? According to rationalist approaches to modal epistemology, science has no substantive role: a priori reflection reveals the structure of modal space, and a posteriori science merely locates us within that modal space, by identifying the actual properties and structures instantiated at our world. According to modal naturalist approaches, science provides evidence about the structure of the underlying modal space. In this paper I distinguish four versions of modal naturalism, with science playing an increasingly robust evidential role, and discuss their plausibility.

## I. Introduction

Science and metaphysics overlap. Within their area of potential overlap is objective modality: the possibilities, necessities and contingencies inherent in nature, if any there be. What bearing does scientific evidence have on objective modality?

A prioristic modal metaphysics is conceived as demarcating a space of possibilities that is epistemically prior to and independent of the discoveries of science. Naturalistic modal metaphysics is metaphysics which brings scientific considerations to bear on modal questions.<sup>1</sup> The greater the role given to science by an approach to modality, the more naturalistic is that approach. In this paper I distinguish four progressively more naturalistic approaches to objective modality and defend the most radical of these naturalisms.

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<sup>1</sup> The type of naturalism I primarily have in mind is what Emery (2023) calls ‘content naturalism’ as opposed to ‘methodological naturalism’; I discuss this distinction further in §III.

As well as the four grades of modal naturalism I shall describe, there is a grade zero: a view of objective modality which is wholly non-naturalistic, giving no role at all to science in addressing modal questions. One may also reject objective modality altogether; views of this sort remain ungraded. Pluralist approaches can mix and match, assigning different grades to different modal subject-matters – so that science can help us to answer some types of modal question, but not all. The aim of this paper is to map out the variety of ways in which scientific evidence and modal metaphysics do – and do not – interact.

In this paper I first investigate what it is for a theory to be naturalistic (§II), canvassing existing accounts of naturalistic metaphysics. I then distinguish between epistemic and methodological forms of naturalism, focusing on an epistemic conception of naturalism in a broadly Quinean tradition (§III). Next I apply my preferred form of epistemic naturalism to the topic of objective modality, outlining four increasingly radical grades of naturalism concerning modal metaphysics, as well as two ways (modal conventionalism and modal rationalism) of denying any meaningful evidential bearing of science on objective modality (§IV). §V is a conclusion.

I use ‘naturalistic’ and ‘naturalized’ interchangeably, employing ‘modal naturalism’ for the view that modal metaphysics should be naturalistic to at least what I below call grade one. My arguments presuppose a broad scientific realism, but not any form of reductionism; I aim to stay neutral on the debate between Humean and anti-Humean views of laws of nature. I also aim not to commit to any particular metametaphysical framework of grounding, truthmaking, or the like.

## **II. What is naturalistic metaphysics?**

The thought that science should somehow constrain metaphysics is widely shared in analytic philosophy at least since Quine. It marks the continuation of the respect for science that was characteristic of logical positivism and logical empiricism into a new philosophical landscape where metaphysical questions are no longer neglected. If metaphysical questions make sense, while science remains our best and most reliable source of evidence about reality, then philosophers of science owe us an account of how to identify the metaphysical implications of our best science.

Amanda Bryant gives a general characterization of naturalistic metaphysics in terms of a gradable notion of ‘scientific responsibility’, and highlights the different roles of scientific evidence, scientific theory, and scientific practice for naturalistic metaphysics:

“The more a metaphysical theory engages... with the empirical data, theoretical insights, and practices of the current sciences, the more scientifically responsible it is.” (Bryant 2017: 97)

Bryant's characterization – intentionally – leaves much open, covering both the content of science and its practice. So: what more specific engagement with natural science makes metaphysics naturalistic in core cases such as the metaphysics of space, time and modality?

We may begin with Quine, who bears some responsibility for the resurgence in the popularity of metaphysics and who introduced the term 'naturalized' into the philosophical lexicon. Note that for Quine, the term 'naturalization' does not pick out some process of making-natural that we apply to metaphysics (zapping our a priori principles with a science ray?) but rather it describes the process of the philosopher becoming naturalized into the community of scientists. A naturalized metaphysician is one who is talking the same language as scientists, weighing the same evidence as them, deferring to them as appropriate, and – perhaps – making constructive suggestions.

Quine was already emphasising continuity between science and metaphysics in 1948:

“Our acceptance of an ontology is, I think, similar in principle to our acceptance of a scientific theory, say a system of physics: we adopt, at least insofar as we are reasonable, the simplest conceptual scheme into which the disordered fragments of raw experience can be fitted and arranged.” (Quine 1948: 16)

And, in 1969, Quine envisaged philosophical questions being subsumed within natural science:

“The old epistemology aspired to contain, in a sense, natural science; it would construct it somehow from sense data. Epistemology in its new setting, conversely, is contained in natural science, as a chapter of psychology.” (Quine 1969a)

On a full-blooded Quinean view, then, metaphysics might be naturalized in virtue of being wholly contained within natural science and/or social science.

Once metaphysicians are naturalized into the scientific community, there is immediate scope for conflict between metaphysical precepts and scientific developments. It is in the spirit of the Quinean approach that these conflicts should generally be resolved in favour of those parts of total theory which have the strongest empirical support – that is to say, not the metaphysical parts. Katherine Hawley remarks that “metaphysical beliefs, like other beliefs, should be empirically adequate, and contemporary science is our best guide to empirical adequacy.” (Hawley 2006, p.465) Similarly Simon Saunders, in the context of apparent conflicts between philosophical principles and quantum physics, urges us to “entertain the possibility that it is our a priori and metaphysical convictions that should be modified, in the light of the physics, rather than that physics should fit in with them as they stand.” (Saunders 1997: 46-47)

Hawley and Saunders count as proponents of naturalistic metaphysics by any reasonable criterion, but they look like traditionalists when viewed alongside James Ladyman and Don Ross, whose polemical *Every Thing Must Go* (Ladyman & Ross 2007) opens with a fierce critique of analytic metaphysics. Ladyman and Ross argue that the entire

project of metaphysics as currently practiced is intellectually bankrupt and that it should be abandoned. They allow only a small residual role for a naturalized metaphysics in the philosophy of the special sciences:

“Any new metaphysical claim that is to be taken seriously should be motivated by, and only by, the service it would perform, if true, in showing how two or more specific scientific hypotheses jointly explain more than the sum of what is explained by the two hypotheses taken separately...” (Ladyman & Ross 2007: 30)

A more targeted critique of contemporary metaphysics comes from Craig Callender, who focuses specifically on the notion of metaphysical possibility:

“there is no interesting species of metaphysical modality that is largely immune to science. Our modal intuitions are historically conditioned and possibly unreliable and inconsistent. The only way to weed out the good from the bad is to see what results from a comprehensive theory that seriously attempts to model some or all of the actual world.” (Callender 2011: 44)

Since long before Kripke (consider Max Black’s two spheres, Hume’s argument against necessary connexions, or Descartes’ argument for mind-body dualism) inferences from conceivability to possibility have been staple fare in metaphysics. It is still frequently assumed in contemporary analytic metaphysics that there is a notion of objective possibility to which conceivability is a reliable guide but one which also reflects what really can happen. The grade three and grade four versions of modal naturalism that I discuss below deny this assumption.

Some naturalistic metaphysicians have looked beyond the constraints that science places on metaphysics, and focused in addition on what contributions metaphysics can make to our understanding of science. Steven French and Kerry McKenzie have argued that even if metaphysics has no epistemic authority over science, still metaphysics might be able to be of use in the project of building total theory – by providing conceptual tools which can be repurposed towards building new interpretations of truculent scientific theories. They call this the ‘toolbox’ approach and illustrate it with the way work in metaphysics (on identity and indiscernibility) has been applied to help explicate structuralist approaches to particle physics. Still, French and McKenzie recognize that the resulting rehabilitation of metaphysics is a very limited one, and they echo Callender’s emphasis on the need to give science the starring role in modal epistemology:

“given the central methodological role of the actual in systematic modal theorizing and physics’ privileged role within it, metaphysicians cannot but engage with the philosophy of physics.” (French & McKenzie 2012: 56-57)

In a follow-up paper the same authors combine the toolbox approach with a very plausible initial compatibility constraint on naturalistic metaphysics: there must be some serious scientific theory which is compatible with any proffered metaphysical system.

“any metaphysical theory invoking entities  $x$  and deployed at some time  $t$  should be compatible with at least some independent, well-supported, overall ‘serious’ scientific theory that directly describes or that is otherwise relevant to those entities, should such a theory exist at that time.” (French & McKenzie 2015: 15)

Though this may seem a rather weak constraint, French and McKenzie argue that it excludes much that is currently practiced under the name metaphysics: they criticize in particular Lewis’s account of the Humean mosaic being “simply asserted as if quantum mechanics never happened” (2015, p.30); and the contemporary debate over fundamental entities is in their view “conducted as though that between Democritus and Anaxagoras remains fit to serve as the model” (ibid., p.30).

The toolbox idea may be deployed not only as an apology for our pursuit of metaphysics, but as a vindication of core parts of its content. Alyssa Ney echoes the Quine-Putnam indispensability argument for the existence of mathematical entities, which holds that entities like numbers and vector fields are indispensable to our best scientific theories, and accordingly maintains we have no option but to acknowledge their existence:

“(PI) We ought to have metaphysical commitment to all and only the entities, structures, or principles that are indispensable to our best scientific theories.

(P2)  $X$  is indispensable to our best scientific theories.

Therefore,

(C) We ought to have metaphysical commitment to  $X$ .” (Ney 2012: 61)

Of course, the devil here is in the detail. How much artifice in formulations of our theories are we allowed? – are theories nominalized as in Field’s programme (Field 1980) permissible formulations, or must we stick with theories as actually employed by institutionally bona fide current science? How do we avoid baking metaphysical assumptions into our judgments of what is and is not indispensable to a given theory? Unless we can give straight answers to these questions, Ney’s indispensability argument places few constraints on the pursuit of naturalistic metaphysics.

The approaches to naturalistic metaphysics I have so far described are epistemic in character; they focus on justificatory relations between metaphysical and scientific beliefs. A contrasting methodological conception of naturalistic metaphysics instead emphasizes continuity between the practice of science and the practice of metaphysics. L.A. Paul (2012) argues that the key commonality between science and metaphysics is methodological: each discipline proceeds by building and refining *models* of the target phenomena. Paul conceives the target phenomena as differing between the disciplines, but nevertheless argues that practitioners of the two disciplines can employ the same general epistemic methods:

“Both fields are interested in discovering truths about entities or features of the world that are sometimes observable, but are often unobservable, indirectly confirmable, and abstract... Both fields rely on a priori reasoning in addition to a posteriori reasoning.” (Paul 2012: 9)

As Paul sees things, we have two largely parallel inquiries with different subject-matters but similar investigative strategies.

The converse of Paul's view is the 'moderately' naturalistic metaphysics advanced by Tahko and Morganti (2017). These authors maintain a continuity of subject-matter between science and metaphysics – they emphasise that there is one world, without differentiation into natural and metaphysical aspects, which both disciplines investigate – but they insist on a sharp distinction between the methods employed by scientists and metaphysicians. The former are supposed to use *a posteriori* methods, while metaphysics itself remains an entirely *a priori* discipline.

The most comprehensive defence of methodological naturalism in metaphysics comes from Nina Emery (2023). Emery draws a distinction between 'content naturalism' and 'methodological naturalism' which aligns with my distinction between epistemic and methodological forms of naturalism. Emery's focus is on defending methodological naturalism through consideration of how argumentative strategies from natural science carry over to specific metaphysical debates; for example, she argues that the same methodological maxims which justify scientists in setting aside global sceptical scenarios as potential explanations for their data will also justify metaphysicians in setting aside interpretations of quantum mechanics with radically revisionary ontologies. In cases like these, considerations of methodological naturalism may actually be in tension with considerations of content naturalism: content naturalists might urge that we follow quantum theorizing to whichever ontology it leads, while methodological naturalists might urge that we follow scientific practice in seeking minimally revisionary alterations to metaphysical theories.

Of course, this discussion has hardly scratched the surface of the different types of naturalism that have been considered historically. But I hope it covers the main lines of thought in the recent literature on science-oriented metaphysics. We can draw out two main strands: naturalistic metaphysics as an epistemic doctrine and as a methodological doctrine. In the remainder of this paper I shall focus on the epistemic form of naturalism, further developing it in §III and applying it to modality in §IV.

### **III. Epistemic Naturalism**

While the epistemic form of naturalistic metaphysics emphasizes the evidential role of scientific results (broadly construed) in justifying our metaphysical beliefs, this doesn't mean that facts about scientific practice (and the predictive, explanatory and technological successes of this practice) are wholly irrelevant. We can distinguish between the practices of science as providing a model for the effective practice of metaphysics (as Paul envisages), and the practices of science as serving as evidence for metaphysics to work from. This latter role for scientific practice is still an instance of epistemic naturalism.

To count as epistemic naturalism, what primarily matters is that evidence that is scientific in origin be brought to bear on questions of metaphysics. This evidence may consist in big-picture considerations such as the success of particular research programs, as well as in more specific considerations such as the results of (say) the quantum double-slit experiment.<sup>2</sup> For a big-picture example, consider arguments from the practice of scientists in treating ‘green’ rather than ‘grue’ as projectible (Goodman 1955) to the existence of natural kinds (Quine 1969b) or natural properties (Lewis 1983). For more specific examples, consider arguments from premises about the success of mathematical analogies in particle physics to conclusions about the fundamentality of symmetries, as put forward by French (2014), or consider arguments from the predominant use of phylogenetic classification in biology to conclusions about the nature of species.

We can put the epistemic conception of naturalism into initial slogan form: “metaphysicians should seek theories which cohere well with our best theories in the natural sciences”. Coherence with natural science is to be understood as an epistemic virtue: so metaphysical hypotheses (from the very general to the very specific) that cohere with natural science are ipso facto more likely to be true. The notion of coherence employed can then just be understood as evidential support: if some theory in natural science were to turn out to be true (false), that would boost (lower) the evidential status of some theory in metaphysics. That gives us:

**Epistemic Naturalism in Metaphysics:** Truths revealed by natural science are evidentially relevant to some metaphysical hypotheses.

As well as the core thesis, we can consider a strengthened version:

**Radical Epistemic Naturalism in Metaphysics:** Truths revealed by natural science are evidentially relevant to every metaphysical hypothesis.

The core thesis, I think, is common ground amongst most self-professed naturalistic metaphysicians. The more radical thesis is obviously more controversial, but it can potentially be derived by combining the basic thesis with a holistic epistemology, such that every hypothesis is (perhaps minimally) evidentially relevant to every other. There are, of course, numerous intermediary views which see science as evidentially relevant to some but not all of metaphysics.

Elsewhere (Wilson 2013a, 2013b, 2020) I have defended a holistic ‘package deal’ approach to naturalistic metaphysics, which harmonizes with the radical form of epistemic naturalism:

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<sup>2</sup> This evidential role of scientific practice can also be applied within science itself. It is natural to understand the non-empirical theory confirmation framework offered by Richard Dawid (Dawid 2013) as bringing evidence about the practices of physics (and the successful historical track record) to bear on difficult-to-empirically-confirm theories such as string theory and inflationary cosmology.

**The Package Deal Approach:** An adequate total theory of the nature of reality will involve both metaphysical and scientific components.

According to the package deal approach, in our inquiries we may in principle modify elements of both science and metaphysics in order to come up with the best package deal – what Quine, following Duhem and Newton, called a ‘system of the world’ (Quine 1975). Ultimately, we compare one complete package deal with another.

Put abstractly, the package deal approach says nothing about the relative epistemic standing of the scientific and metaphysical components of total theory. However, most naturalists would agree that our theories in natural science have a much stronger independent evidential basis than our theories in metaphysics. So, *ceteris paribus*, we should expect to modify metaphysics to fit in with natural science more extensively than vice versa when constructing an optimal package deal. This reflects the fact that multiple rival metaphysical views are typically understood to be empirically adequate, whereas with most of our central scientific theories the evidence strongly favours them over salient rivals (consider the atomic theory of matter, quantum electrodynamics, etc.) While from the naturalist perspective our best total explanatory account of the frequency spectrum of a star has both metaphysical and scientific components, the physics component is indispensable to the specific prediction and the detailed explanation, so it accrues greater evidential support.

Epistemic naturalism about metaphysics has consequences for the epistemology of science, not just for the epistemology of metaphysics. Since the relation of evidential relevance is symmetric (for any propositions P and Q with probabilities between 0 and 1, if P evidentially bears on Q then Q evidentially bears on P), epistemic naturalism in metaphysics enforces the corresponding thesis of epistemic metaphysicalism in natural science:

**Epistemic Metaphysicalism in Natural Science:** Truths revealed by metaphysics are evidentially relevant to some natural scientific hypotheses.

However, given that our theories in natural science have a much stronger independent evidential basis than our theories in metaphysics, natural science remains *de facto* a better guide to metaphysics than metaphysics is to natural science.

The general conception of epistemic naturalism I have described in this section is compatible with degrees of naturalisticness. Different metaphysical theories may differ with respect to how strongly discoveries in natural science bear evidentially on them. In short: some metaphysical theories are more epistemically naturalistic than others. In the rest of the talk I’ll focus on a key case study: modality. To what degree can the results of natural science bear evidentially on the metaphysics of objective modality?

#### IV. Four Grades of Modal Naturalism

Because modality is central to metaphysics and its core argumentative methods, the theory of objective modality is a particularly important testbed for naturalistic metaphysics. Naturalistic critiques of metaphysics often diagnose the core methodological problem with metaphysics as its reliance on intuitions about possible worlds; this tendency is exemplified by the extracts above from Ladyman & Ross and from Callender. Conversely, rationalist metaphysicians such as E.J. Lowe and George Bealer have explicitly characterized metaphysics as the a priori science of the possible. And modality has seemed distinctively resistant to naturalistic treatment, in a manner reminiscent of morality and mathematics; Price and Jackson (1997) call these subject-matters the ‘M-worlds’. An adequate naturalistic account of objective modality accordingly promises a foundation for a broader naturalistic metaphysics.

With a nod to Quine’s three grades of modal involvement (Quine 1955), I shall classify approaches to objective modality into six categories, depending on how much evidential bearing they allow science to have upon metaphysics. Two of my categories are not forms of naturalism about objective modality at all; the remaining four categories are increasingly potent forms of modal naturalism.

**[Ungraded:** There is no such thing as objective modality.]

**[Grade Zero:** Scientific evidence has no bearing on objective modality.]

**Grade One:** Scientific evidence can support expanding our view of the objective possibilities.

**Grade Two:** Scientific evidence can support contracting our view of the objective possibilities.

**Grade Three:** Scientific evidence can support contracting our view of the structure of the objective possibilities.

**Grade Four:** Scientific evidence can bear on what objective possibilities are.

Grades one, two and three are ways for the content of science to bear on the modal reality’s extension; grade four is a way for the content of science to bear on modal reality’s constitution. Each grade strictly extends the previous grade.<sup>3</sup>

Recent forms of modal conventionalism (Sidelle 1989; Sider 2011; Cameron 2010), modal nihilism (van Fraassen 1977), and modal normativism (Thomasson 2020) deny that there is any such thing as objective modality. If they are right, then there are no objective modal facts to be naturalistic about. These positions are ungraded in the present classification:

**[Ungraded:** There is no such thing as objective modality.]

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<sup>3</sup> Grade 4 is to some extent orthogonal to lower grades; however, insofar as the constitution of possibilities is relevant to which possibilities there are, grade 4 views will tend to bring the lower grades along with them. Thanks to Jessica Leech for discussion here.

If there is no such thing as objective modality, then no scientific discoveries can in principle be relevant to either the nature or extension of objective modality. Modal truths, insofar as there are any, are completely conventional and/or normative: they are constitutively dependent on human conceptual or linguistic activity.

To obtain a grade in the current classification scheme, a position needs to recognize at least some form of objective modality. The least naturalistic of the major contemporary positions is modal rationalism, a term which I'm using for views which deny any substantive connection between science and metaphysical modality. Amongst leading recent proponents of modal rationalism are George Bealer, E.J. Lowe, and David Chalmers. Modal rationalists need not deny that science bears on any form of objective modality. Nomological possibility is compatibility with the laws of nature, and science (obviously!) bears on what the laws of nature are (if there are any). But given modal rationalism, the metaphysical modal facts are fixed a priori, and science merely discovers which of the a priori possibilities are nomologically possible. Scientific input doesn't provide information concerning modality itself, but only serves to catalogue the actual properties.

The feature of modal rationalism which is defining for my purposes – that the space of background objective possibilities is fixed a priori – may be somewhat occluded by common two-dimensionalist manoeuvres. For example, Chalmers's two-dimensional semantics provides us with a kind of modality – which he calls 'secondary possibility' – with respect to which the actual facts about identities between individuals and natural kinds are held fixed. Since knowledge of the actual facts about identities requires a posteriori input, the facts about secondary possibility inherit that a posteriori aspect. But, for modal rationalists, this role of empirical input in identifying which individuals are which is wholly disentangleable from the a priori task of characterising a background space of objective possibilities which remains neutral on identity claims. This background space is Chalmers' 'primary possibility'. Since he takes primary possibility as basic, and secondary possibility as derivative, Chalmers' view remains at level zero of the modal naturalist hierarchy. Likewise, although Bealer sees a role for empirical investigation in establishing that water is in fact H<sub>2</sub>O, he sees the necessity associated with this identity claim – and with all the necessities which may follow from it – as flowing from a purely a priori set of modal principles.<sup>4</sup>

While modal rationalists may or may not recognise a substantive notion of nomological possibility accessible to scientific investigation, they invariably recognize an a priori notion of objective modality which is prior to nomological modality. This background space of objective possibility – including the range of objectively possible laws of nature, is completely isolated from scientific evidence.

**[Grade Zero:** Scientific evidence has no evidential bearing on objective possibility.]

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<sup>4</sup> Goswick (2010) shows how a priori and a posteriori aspects of Bealer's view can be disentangled.

I would attribute grade zero views to Armstrong (1983), Bealer (1987) and Lowe (1998), but I have the impression that they are widespread in analytic metaphysics.

To move beyond grade zero, a position needs to allow at least some evidential bearing of scientific evidence on objective modality. The most modest way of allowing for this is to allow that scientific progress may lead us to recognise new objective possibilities which were not apparent a priori: that is, scientific progress may lead us to expand our conception of objective modal space<sup>5</sup>.

**Grade One:** Scientific evidence can support expanding our view of the objective possibilities.

Philosophers at grade one allow that science can reveal metaphysical possibilities where a priori reflection cannot. Here it is worth, following Chalmers (2002), distinguishing negative and positive understandings of ‘a priori possibility’. Where negative a priori possibilities are possibilities which could not be ruled out a priori, positive a priori possibilities are possibilities which can be known a priori. Grade one involves the claim that some negative a priori possibilities can be known to be possible – or at least, evidence can be obtained for their possibility – through a posteriori methods.

Candidate examples of science-evidenced expansion of objective possibility are not hard to come by, and they typically often highlight how previous assumptions about objective possibility were themselves heavily conditioned by the prevailing science of the time. Perhaps the clearest example is the 20<sup>th</sup>-century transition, under the influence of relativistic physics, from the Kantian view that space and time necessarily have a Euclidean metric to the contemporary view that they possibly (indeed, actually) have a Riemannian metric. The existence of possible spacetimes with Riemannian metrics is something that we acknowledge because our best science invokes such spacetimes. Putnam (1968) offered a clear account of the way in which recognition of relativistic spacetime expands our view of the space of possibilities. He concludes “what was yesterday’s evident impossibility is today’s possibility...” (Putnam 1968: 217-218).

Other potential examples are more contentious. Did Darwin, in conclusively overturning Aristotelian ideas about species fixity, establish the possibility of one animal species changing into another? Quantum theory is a particularly rich source of alleged examples: it has been said to have established the possibility of causation at a spatial distance (see Maudlin 1996 for discussion), of retrocausation (Friederich 2019 gives a survey), of metaphysical indeterminacy (J. Wilson 2012, Wolff 2015, Calosi & J. Wilson 2018), or of failures of the supervenience of the global on the local (see Healey 2016 for a survey), or a world which is entirely relational in character (French 2014). Even someone as associated with a priori metaphysics as David Lewis, for example, claimed to be willing in principle to recognise the possibility of ‘unHumean whatnots’ in light of quantum theory (Lewis 1986).

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<sup>5</sup> Depending on one’s conception of how modality is constituted, this may amount to recognizing more objective possibilities, or recognizing fewer constraining necessities.

Block (1997) argues that phenomenal consciousness outstrips access consciousness – something which has seemed a priori impossible to many historical and contemporary Cartesians.

Some examples are very contentious indeed; it might be said that the Libet experiments show that there are possibilities in which human free action was reliably predictable in advance, or that quantum mechanics shows us that it is possible for true contradictions to obtain (Putnam 1968, again), or that quantum gravity shows us that fundamental reality need not be spatiotemporal (Rovelli 2010).

In many of these cases phenomena are judged to be possible in light of being judged to be actual: recognition of the possibility of curved spacetime comes hand-in-hand with the realisation that our own spacetime is curved. But this is not an essential feature of grade one: in many cases, possibilities are established scientifically despite not being, so far as we know, actually realized. This is in general enabled by the centrality of model-based reasoning in science: confirmation of a theory thereby provides confirmation of the possibilities encompassed by its models. Examples may include specific super-heavy chemical elements such as unsepttrium (atomic number 173), predicted to behave like a highly reactive alkali metal and then to decay within a few microseconds (Fricke & Soff 1977), or exotic seven-dimensional emergent spacetimes from the distant reaches of the string theory landscape.

The common factor linking all these cases is hopefully clear: some scientific theory (perhaps under a controversial interpretation) is leading us to regard as objectively possible something that we previously thought too outlandish to be possible. Of course, it is not as though modal rationalists who opt to remain at grade zero cannot give some account of these cases. Their explanations will typically be given in terms of a heuristic role for scientific investigation in supporting a substantive role for a priori reasoning; the science encourages us to look again at assumptions which we had falsely believed – through insufficiently careful inspection – could be ruled out a priori, whereas – on closer inspection – these can instead be ruled in a priori. In Bryant & Wilson (forthcoming), further discussion of these cases is provided, and it is argued that they better fit the grade-one model than the grade-zero model.

In sum, at grade one, scientific evidence can help establish objective possibilities where a priori reflection cannot. The most natural way to move beyond grade one is to recognize in addition cases where scientific progress leads us to excise possibilities which we previously recognized from the space of objective possibilities. This typically happens when we learn facts about the underlying constitution of things in a way which undermines distinctions we previously drew.<sup>6</sup>

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<sup>6</sup> Russell (2015) offers a formal treatment of the objectivity of distinctions and of our reasoning about them.

**Grade Two:** Scientific evidence can support contracting our view of the objective possibilities.

Moving beyond grade one has been discussed by philosophers most explicitly in the literature on laws of nature. Influenced by Kripkean ideas about the necessary a posteriori, a number of authors (e.g. Shoemaker 1980, Swoyer 1982, Fales 1993) have proposed a treatment of scientific properties as picked out by natural kind terms, and hence as generating Kripkean a posteriori necessities. This line of thought culminates in the dispositional essentialism of authors like Ellis (2001) and Bird (2007), who argue that laws of nature are a posteriori necessities which flow from the dispositional essence of natural properties such as mass and charge. Dispositional essentialism is not the only motivation for views in this vicinity, though; Edgington (2004), Leeds (2007) and Wilson (2013b) offer a selection of different motivations.

The consequences of dispositional essentialism depend greatly on what possibilities we acknowledge concerning alternative fundamental laws of nature. Most dispositional essentialists acknowledge the metaphysical possibility of ‘alien’ fundamental properties governed by ‘alien’ laws; Bird (2007) labels the resulting position ‘weak necessitarianism’. A minority, including Vetter (2015), deny the possibility of alien properties governed by alien laws and instead endorse the ‘strong necessitarian’ view that all genuine possibilities share the fundamental laws of the actual world. (Bird remains agnostic between the weak and strong forms.)

While popular, weak necessitarianism is not as interesting or consequential a view as it might initially appear. A natural challenge arises: is grade two a mere redescription of grades zero or one? Grade two is compatible with the view that scientific discoveries only bear on what can happen by bearing on which properties are which. If there is a possible set of laws which generates any conceivable pattern of behaviour, then any necessity of the laws is not a matter of a restriction on what patterns of behaviour really can happen; it is merely a restriction on which patterns of behaviour can count as instances of which properties. Weak necessitarianism then seems to boil down to a view about property individuation rather than a view about the limits of objective possibility. Strong necessitarianism restricts the range of possible patterns of behaviour directly, and accordingly it has more substantive metaphysical consequences. Schaffer (2005), Bird (2007) and Wilson (2013b) explore the relative merits of the various necessitarian views in more detail.

For present purposes, the distinction between strong and weak necessitarianism is of interest because it corresponds to a well-motivated way to move beyond grade two. For weak necessitarians, the scientific discovery of new objective impossibilities may amount to nothing more than the empirical identification of the specific laws which govern actual fundamental properties. If the actual fundamental laws ensure that energy is conserved, then weak necessitarians obtain the impressive-sounding result that violations of energy conservation are objectively impossible. The less impressive-sounding catch is that weak necessitarians still recognise countless genuinely possible, perfectly energy-resembling,

properties which are not universally conserved; it is just that these properties are numerically distinct from energy itself.

For strong necessitarians, by contrast, science discovers more profound impossibilities. If the actual world respects conservation of energy, then any pattern of behaviour corresponding to the violation of conservation of any energy-resembling property is genuinely impossible. I will refer to these restricted patterns of possible behaviour as structural features of modal space, allowing statement of a next grade of modal naturalism.

Grade three modal naturalism says that science can provide evidence against structural possibilities where a priori reflection cannot:

**Grade Three:** Scientific evidence can support contracting our view of the structure of the objective possibilities.

There might for example be no possibilities with more than 11 spacetime dimensions – and not just because certain 11-dimensional structural possibilities would not deserve the name spacetime, but because there just are no possibilities whatsoever of the relevant kind.

Talk of the structure of the objective possibilities can be cashed out in a number of ways. What matters is that we be able to characterise resemblance between actual properties and merely possible properties, so that we can say that no property of a given type is possible. We accordingly need to be able to classify fundamental properties into types. One option would be the property counterpart theory of Mark Heller (1998) – grade three modal naturalism would amount to claims about which counterparts for our actual fundamental properties do and do not exist. Another option would be to follow Vetter (2015) in arguing that the objective possibilities are grounded in the potentialities of actual objects.

In my view, grade two is hardly a more robust naturalism than grade one, whereas grade three is a modal naturalism fully worthy of the name. Authors who have defended some form of grade three modal naturalism include Edgington (2004), Leeds (2007), Ladyman and Ross (2007), Wilson (2013b), French (2014). A consequence of grade-three modal naturalism is that nomological modality and metaphysical modality coincide. At grade three, science discovers a posteriori constraints on metaphysical possibility in virtue of identifying the actual fundamental laws of nature. Modal epistemology is assimilated into scientific epistemology more generally.

Grade three is radically naturalistic by most standards; it corresponds to the most a posteriori end of the spectrum of views of modality considered by Sturgeon (2010). An even more radical form of naturalism is however possible, an approach which goes beyond linking science to the extension of modal space and in addition links science to the underlying constitution of modal space. Modal naturalisms of the grade four kind bring scientific evidence to bear on the question of what possibility and impossibility themselves are, not merely on what specific things are possible and impossible:

**Grade Four:** Scientific evidence bears on what objective possibilities are.

Describing grade four in the abstract, it might be hard to see how any scientific theories could possibly be relevant to the question of the underlying constitution of modal space. To see what this grade involves it will be easiest to proceed via a case study of a particular grade four view.

In Wilson (2020) I argued that objective modality may be located in the physical world under the guise of the parallel worlds of many-worlds (Everettian) quantum theory. The basic idea is that metaphysical contingency is variation across different branches of the quantum state of the universe (different *Everett worlds*). Quantum modal realism makes contingency into an emergent phenomenon. At macroscopic levels, laws are indeterministic and physical reality is contingent. At the fundamental level, laws are deterministic and physical reality is non-contingent. The quantum modal realist theory may be captured in the following three core principles (Wilson 2020: 22):

**Alignment:** To be a metaphysically possible world is to be an Everett world.

**Indexicality-of-Actuality:** Each Everett world is actual according to its own inhabitants, and only according to its own inhabitants.

**Everettian Chance:** The objective chance of an outcome is the quantum weight (squared amplitude) of the set of Everett worlds in which that outcome occurs.

In my view, these principles (and especially Alignment) do important work in securing the basic viability of Everettian QM – so they are part of the scientific package after all. But, even setting that aside, they might still be evidentially supported by science in virtue of being the metaphysical principles that fit most naturally with the science into a broader package deal.

In the dialectic of the present paper, the quantum modal realist proposal serves as proof of concept for a grade four approach. However, grade four views might take a wide variety of forms. Another example of a grade four view would be Graham Priest's empirically-based case (Priest 1987) for dialetheism. Priest argues that dialetheism provides a natural resolution of the interpretive difficulties of quantum theory, by associating macroscopic superpositions with true contradictions. Since not all candidates for the role of possible worlds can easily accommodate contradictions, empirical support for contradictions also amounts to empirical evidence bearing on the kinds of things worlds could be like.<sup>7</sup> Some of the remarks of ontic structural realists (Ladyman and Ross 2007; French 2014) about the fundamentality of symmetries to the modal structure of the world may also be best understood in terms of a grade four approach. If the modal structure of the world is partially constituted by symmetries, and science can empirically discover these symmetries, then science can empirically bear on the constitution of modal reality. No doubt other grade four views are out there.

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## V. Conclusion

Epistemic naturalism, of the broadly Quinean kind, is a useful way to characterize naturalistic metaphysics. The resulting characterization allows for degrees of naturalisticness, and different accounts of modality come out as naturalistic to greater or lesser degrees. I hope that this taxonomy helps to clarify what it takes for our theory of modality, and for our metaphysics more broadly, to be naturalistic; that has been my primary aim in this paper. My secondary aim has been to argue that we ought to be open to theories of modality that are more naturalistic than has previously been thought feasible.<sup>8 9</sup>

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