DOI 10.36446/af.e1196

MODAL NATURALISM, LAWS OF NATURE, AND THE ASYMMETRIES BETWEEN POSSIBILITY AND NECESSITY

Naturalismo modal, leyes de la naturaleza y las asimetrías entre la posibilidad y la necesidad

Vassilis Livanios [a]
https://orcid.org/0000-0002-9424-2013
vlivan01@ucy.ac.cy

[a] University of Cyprus, Nicosia, Cyprus.

Abstract

In their (2024), Bryant and Wilson present Modal Naturalism (MN) as an epistemology of objective modal facts which is based on the view that science is our primary source of evidence concerning those facts. They argue that modal naturalists should be nomic necessitarians because only in that way they can provide convincing examples of objective necessities in nature. In this paper, however, I argue that various cases of non-trivial counter-nomic reasoning in science strongly suggest that modal naturalists should accept objective counter-nomic possibilities that according to Wilson's own view (2021) cannot be plausibly accommodated by nomic necessitarianism. Given that, nomic contingentism should be the favourite view of modal naturalists. In addition, I offer a MN-friendly definition of metaphysical possibility that minimises the evidential role of intuitions and so assuages the worry that nomic contingentism could bring back to the fore modal intuitions as sources of modal knowledge. Finally, I reply to the accusation that nomic contingentism raises (within the context of MN) epistemic asymmetries between possibilities and necessities by arguing that contingentist modal naturalists can provide knowledge of robust objective necessities but, on pain of refuting their own view, those necessities cannot be about fundamental nomic facts.

Key words: Laws of Nature; Naturalism; Nomic Contingentism; Modal Necessitarianism.

Resumen

En su (2024), Bryant y Wilson presentan el Naturalismo Modal (NM) como una epistemología de los hechos modales objetivos, basada en la idea de que la ciencia es nuestra fuente principal de evidencia con respecto a esos hechos. Argumentan que los naturalistas modales deberían ser necesitarianos nómicos porque solo así pueden proporcionar ejemplos convincentes de necesidades objetivas en la naturaleza. En este artículo, sin embargo, argumento que varios casos de razonamiento contranómico no trivial en la ciencia sugieren fuertemente que los naturalistas modales deberían aceptar posibilidades contranómicas objetivas que, según la propia visión de Wilson (2021), no pueden ser acomodadas plausiblemente por el necesitarianismo nómico. Dado esto, el contingentismo nómico debería ser la visión favorita de los naturalistas modales. Además,

ofrezco una definición de posibilidad metafísica amigable con el NM que minimiza el papel evidencial de las intuiciones y, por lo tanto, atenúa la preocupación de que el contingentismo nómico podría traer de vuelta a primer plano las intuiciones modales como fuentes de conocimiento modal. Finalmente, respondo a la acusación de que el contingentismo nómico plantea (dentro del contexto del NM) asimetrías epistémicas entre posibilidades y necesidades, argumentando que los naturalistas modales contingentistas pueden proporcionar conocimiento de necesidades objetivas robustas, pero, so pena de refutar su propia visión, esas necesidades no pueden ser sobre hechos nómicos fundamentales.

Palabras clave: Leyes de la naturaleza; Naturalismo; Contingentismo nómico; Necesitarianismo modal.

1. Introduction

Relatively recently, a new brand of metaphysics, Metaphysics of Science (MoS), has bloomed in apparent opposition to largely a prioristic metaphysics. Although the distinction between them has sometimes been made in terms of content, it seems that the main difference is one regarding methodology and epistemology; MoS mostly appeals to science (that is, scientific findings and practice) and downplays a priori argumentation, whereas a prioristic metaphysics gives much weight to a priori considerations often based on rational intuitions. Of course, things are subtler, and this situation has an impact to both the clarity of the distinction and the strength of motivating reasons for embracing MoS. In particular, the distinction is blurred because scientific reasoning itself involves (sometimes to a large degree, such as in mathematics) a priori elements. And the very motivation for MoS, which is partly based on the belief that the 'opponent's' epistemology is inferior qua based on problematic and unreliable intuitions, is defeated by the observations that, first, practicians of MoS themselves give sometimes considerable weight to intuitions, and second, not all a priori argumentation in a prioristic metaphysics is grounded in intuitions (for further discussion, see Livanios, 2019).

This paper focuses on a view, Modal Naturalism (MN), which, under the proviso that there is a class of *objective* modal facts, promises an epistemology for knowing those facts that inherits its reliability and credentials by science itself. In particular, the paper examines two issues that have been most recently (2024) discussed by Amanda Bryant and Alastair Wilson (henceforth, B&W) in their exposition of the core tenets of MN. The first issue concerns the way that one's preferred view about the modal status of fundamental laws (that is, whether one embraces nomic necessitarianism or nomic contingentism) affects MN. B&W argue

that a careful consideration of this issue shows that there are limits to their intended metaphysical *neutrality* within the context of MN. I agree with this upshot but, as I argue in the sequel, for different reasons than those B&W present. In my view, MN cannot be neutral vis-à-vis the nomic necessitarianism vs nomic contingentism debate on pain of extensional inadequacy. The second issue regards epistemic asymmetries between possibilities and necessities that arises in the context of MN. This paper sheds new light on these asymmetries by commenting on B&W's discussion of their (alleged) impact on modal naturalists' preferred view about the modal status of laws of nature.

Here is the plan: the following section sets the stage for the subsequent discussion presenting (and briefly commenting on) the core tenets of MN as exposed in B&W's (2024). Section 3 includes arguments in favour of a nomic contingentist version of MN, while Section 4 assuages the worry that the adoption of nomic contingentism is not MN-friendly because it brings back to the fore the modal intuitions. In Section 5 I discuss two asymmetries between possibility and necessity in the context of MN and argue that they give us no reason to prefer nomic necessitarianism over nomic contingentism. Finally, section 6 briefly presents the upshots of the paper.

2. Modal Naturalism: Core Tenets

According to B&W (2024, p.1), the definitional principle of MN is that "science (construed broadly) is our primary source of evidence concerning the modal facts." Three remarks are worth saying for this definition. First, MN does not restrict (for its purposes) science to (fundamental) physics "but includes the natural sciences more broadly, social science, and mathematics." (2024, pp. 9-10). Second, although modal naturalists *can* be uniformists and insist that science is our *only* way to modal knowledge, it seems better to take a non-uniformist view (that is, allow multiple routes to modal knowledge but nonetheless think that following science is the *best* way to know truths about possibilities and necessities) because non-uniformism is compatible with all versions of MN (more on those versions in the sequel). Third, the term "evidence" is conceived here in broad terms "such that any information which bears on rational degree of belief counts as evidence" (2024, p.12).

MN presupposes that there are modal facts falling under an *objective* kind of modality and, as a result, rules out conventionalist (Sidelle, 1989), projectivist (Blackburn, 1993) and eliminativist (Quine, 1976) accounts of modality. Two comments on that: first, although B&W do not discuss how

the different views about science affect the project of MN, it is plausible to think that scientific *realism* is presupposed in order for modal naturalists to justifiably claim that they can draw *objective* modal information from science. Otherwise, what we find possible by following the methodology of MN (which is, at least partly, based on what scientific theories say) should most plausibly be regarded as *epistemically* possible; for, what is not ruled out by what we know from our best *current* theories may be ruled out by what we currently do not know (and perhaps will be revealed by future theories). Second, the fact that MN seeks modal facts 'out there' explains why, though it is a theory of modal epistemology, it is nonetheless intimately related to metaphysics. For if, following MN, we do find which *are* the modal facts, then we effectively answer an ontological question.

MN's focus on objective modality raises naturally the question: is this objective modality one of the well-known extant kinds (physical or metaphysical) or is it a novel one? If the latter, what is the relation between this new modality and the 'traditional' ones? B&W give us a hint about the answer to the latter question when they claim that the modality they talk about goes *beyond* physical (aka, nomic) modality (2024, p.6). Yet, although the usual candidate for such a kind of modality is the (Kripkean) metaphysical one, B&W are not committed to the view that the target of MN are facts associated with such metaphysical modality (2024, p.6). In Section 4, I will suggest a MN-friendly notion of metaphysical modality but, for the time being, let's only assume what is uncontroversial about MN: this modal epistemology aims to reveal which entities, properties, facts, etc. are objectively possible or necessary and to do that it appeals mostly or exclusively (depending on the version), but in any case *primarily,* to science.[1]

B&W distinguish between two versions of MN: *Descriptive* and *Prescriptive*. The former is based on the view that science *actually* plays a key role in modal epistemology, irrespective of whether it *could* be replaced by pure a priori considerations of ideal reasoners or knowers quite unlike us. The latter takes a step further by saying that science is *indispensable* in modal epistemology. B&W also claim that MN is a species of naturalism according to which it is the *content* of best scientific theories that put epistemic constraints on the content of metaphysical theories. My

[1] B&W point out that there are two ways for mature successful scientific theories to show that something is possible. First, they can reveal what is possible by discovering what is actual. Second, they can also reveal what is *merely* possible (that is, possible but non-actual) through their models. For "a model of some physical theory corresponding to the actual world is part of a larger set of models, and attending to those models can give us evidence for the possibilities to which they correspond" (2024, p. 52).

interpretation of this claim is that B&W contrast their naturalism with what Nina Emery (2023) calls *methodological naturalism* (i.e., the view that metaphysicians should, whenever possible, use the same methodology that scientists use) and not with a kind of naturalism that appeals to both scientific findings *and* scientific practice. There are two reasons that support such an interpretation: first, embracing the latter construal of "content naturalism" would create a tension with what Wilson himself argues for elsewhere. More precisely, in his (2024), and while talking about epistemic naturalism in general, Wilson explicitly defends the appeal to scientific practice in a naturalist context:

> 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 (2024, p.122).

Given the above, there would be an obvious tension if we would interpret the term "content naturalism" in such a manner as to exclude the appeal to scientific practice.

The second reason is that if modal naturalists excluded scientific practice as a possible source of evidence for modal facts, then they would be caught in the following dilemma: Either they should hold that scientific practice does not have any impact on *all* metaphysical issues or embrace the view that modal matters have *special* features making only them 'insensitive' to scientific methodology and practice. Following the first horn seems difficult in the light of Emery's (2023) arguments for what she calls "the content-methodology link": that is, that content naturalists should also be methodological naturalists. If the answer to Emery's question "why believe in the content of our best theories if we simultaneously think that the methods arriving to it are unreliable?" leads naturally to the content-methodology link, it is difficult to defend the view that scientific practice is irrelevant to (at least some) metaphysical conclusions. For, although Emery's methodological naturalism differs from the view that we can take into account scientific practice in order to reach metaphysical conclusions (or, at least, shed light on metaphysical issues), her question make us realise that there is no cogent reason to think that in the naturalistic context only

scientific content can provide evidence for metaphysical conclusions.[2] On the other hand, following the second horn seems equally difficult. In any case, it is the burden of modal naturalists to bring to light the special feature of modal issues that make them 'insensitive' to the scientific practice.

To conclude my brief presentation of the basic tenets of MN, here are two more features that according to B&W characterise it. The first feature is that MN in general does not aim to provide a theory of modality, although, in its strong version (see Wilson 2020) MN does provide such a theory. In this sense, MN aims to be neutral regarding the various theories of modality (B&W, 2024, p. 5). Finally, regarding the place of MN vis-à-vis the various versions of naturalistic metaphysics, B&W point out that MN allows that "metaphysical inquiry may address subject matters which are at least partly distinct from scientific subject matters and that metaphysical inquiry may appeal to certain tools or methods which are not directly employed by science." (2024, pp. 7-8). Moreover, the epistemic constraints arising from science can reduce, but unfortunately not eliminate, the metaphysical underdetermination of metaphysical theories by scientific evidence (2024, pp. 8-9).

3. Modal Naturalism and the Modal Status of Laws

Metaphysicians of science have repeatedly highlighted the implications of taking into account scientific findings and practice when examining various metaphysical issues.[3] Although they have most often argued that scientific results and practice can support (albeit controversially, due to metaphysical underdetermination) one of the extant rival views about a metaphysical issue[4], it is important to realise that science can also extend the range of the alternative views which otherwise is often limited by common-sense-based intuitions. For example, consider the metaphysical issue of the interworld identity (or, more generally, the de re modal representation) of the actual fundamental properties. Philosophers have traditionally suggested that dispositional essences, quiddities, and laws of nature are the only pertinent 'features' that may determine the interworld

[2] Waters (2017) defends the appeal to scientific practice. For an example which considers renormalization techniques in physics to reach an upshot regarding the nature of fundamental properties, see Livanios (2017).

[3] Other common objectives of metaphysicians of science is revealing the metaphysical presuppositions of science and developing metaphysical interpretations of scientific theories.

[4] Consider, for instance, the extensive discussion on the impact Special Theory of Relativity has for the prospects of presentism in philosophy of time.

identity of fundamental properties. Yet, by considering specific scientific findings about the invariants of fundamental symmetries, MoS brought to the fore an alternative option: the identity of fundamental properties can be determined by the higher-order property "being invariant under the action of the symmetry X", which for various 'values' of X characterizes different fundamental properties.[5] Now, although MN is not a metaphysical theory, it clearly aims to provide an epistemology of modality which is friendly with MoS projects. The aim of this section is to examine whether its science-based methodology (like the methodology of some MoS projects) has an impact on the metaphysical issue regarding the modal status of laws of nature.

To begin with, let us recall that there is a debate between those philosophers (nomic necessitarians[6]) who hold that the actual laws of nature are the laws of all possible worlds (Bostock, 2003) and those (nomic contingentists) who embrace the opposite view and allow an interworld nomic variation (Armstrong, 1983; Lewis, 1994). Typically, the proponents of the two rival views agree on the hypothesis that *all* actual laws should be either necessary or contingent, but recently some dissenting voices have argued for *hybrid* views according to which some nomic features should be regarded necessary and some contingent (Tahko, 2015; Hireche et al., 2021)[7]. Although (as mentioned in the previous section), B&W aim to be neutral regarding the various theories of modality, they insist that they *cannot* remain neutral concerning the nomic contingentism vs nomic necessitarianism debate. The reason is that, according to them, it is only by embracing nomic necessitarianism that an adequate version of MN can be developed. More precisely, B&W argue that nomic contingentism

[5] Livanios (2017, p. 75) suggests that the interworld identity of mass can be determined by the second-order feature "being invariant under the action of the Poincaré group of symmetry transformations", while the interworld identity of electric charge by the feature "being invariant under the action of the U(1) group of symmetry transformations".

[6] According to a *weak* version of nomic necessitarianism, the actual laws hold only in all possible worlds in which the actual properties exist. Here I focus on the *strong* version of necessitarianism in which actual properties exist in all possible worlds and the actual laws hold in all possible worlds too. In what follows, however, for reasons of simplicity, I will drop the qualification "strong". Wilson (2021) makes the same distinction, but he calls the weak version nomic necessitarianism and the strong version modal necessitarianism.

[7] According to Tahko's (2015) view, those laws that feature a fundamental natural kind are metaphysically necessary and those that do not are contingent. In Hireche et al. (2021) view, kinematical laws are metaphysically necessary, whereas dynamical laws concern the metaphysically contingent development of the states of physical systems constrainted by the broader space of possibilities determined by the kinematical laws. Most recently, Kimpton-Nye (2022) has argued that within the context of a powers-based best system account, laws of nature are in a sense *both* necessary and contingent.

undermines any suggested examples of objective necessity (as they understand it) because a contingentist can interpret any statement of putative 'broad' objective necessity as a case of merely *nomic* necessity (2024, p.15). Hence, prospective proponents of MN who also follow nomic contingentism will find themselves in the difficult situation of not being able to give convincing examples of necessity in nature.[8]

The structure of B&W's argumentation is the following: they start from the assumption that MN is the friendliest to MoS modal epistemology. Then, after a closer look, they realise that the plausibility of MN is compromised if it is placed within a nomic contingentist context. Given that, they conclude that modal naturalists should be nomic necessitarians. B&W's conclusion then is *conditional* on the acceptance of MN: If we have reasons to be modal naturalists, then we have reasons to be (should be?) nomic necessitarians. Since I am sympathetic to the whole project of MN, it is not my intention to challenge the antecedent of the above conditional statement. Rather, the arguments to come aim to challenge the conclusion reached in the consequent.

Let me begin by repeating the core tenet of MN: science is our primary source of evidence concerning the (objective) modal facts. This principle refers to science in a broad manner, but in the case of modal facts closely associated with physics, the source of the relevant evidence is primarily what we may call the *nomic web* (that is, laws and the relations among them, symmetries and the relations among them and among them and the laws). Now, it is true that both scientific argumentation and practice have modal aspects, a fact that recently has been stressed by a number of philosophers. Williamson (2018), for example, points out that a typical practice of physicists is to study a physical system by analysing its state space which is the abstract space of its *possible* states[9]. Modeling is another aspect of scientific practice that often involves modality. As Wirling and Grüne-Yanoff (2025, pp. 28-29) point out, some modeling practices aim to deliver modal information about their targets. Toy, exploratory and hypothetical modeling practices can support possibility claims that serve

[8] This would also raise an asymmetry between possibility and necessity because B&W argue that the advocate of MN *can* provide cogent examples of objective possibility. For further discussion on this issue, see Section 5.

[9] In his words: "The natural understanding of the states in an application is as possible states of the system. We cannot discard all states outside the actual orbit, because the geometrical or topological structure is defined over the set of states as a whole, not over a single orbit. Since the mathematical power of the theory depends on that structure, the utility of the application depends on retaining all the states, including the counterfactual ones" (2018, pp. 199-200).

to refute necessity claims (Grüne-Yanoff, 2009) or delineate the space of possibilities regarding a phenomenon (Massimi, 2019).

Both state spaces and many of the modeling practices involve *nomic* modality, that is, they concern possibilities allowed by the actual nomic web and necessities entailed by the actual nomic web. It is interesting, however, that scientists sometimes take seriously possibilities that are nomically impossible. Following Tan (2019), we can find evidence for this from at least three aspects of science: scientific explanation, modeling practices and evaluation of theories (both superseded and contemporary rivals to the present ones). Although Tan's examples aim to show that, in some cases, scientific practice involves the evaluation of subjunctive conditionals with *metaphysically* impossible antecedents, I will show that there are examples that fall under the aspects of scientific practice that Tan describes which involve counter-*nomic* reasoning (more precisely, they involve subjunctive conditionals with nomically impossible antecedents). But before presenting those examples, it is important to stress the following point: for those philosophers who think that metaphysical modality is identical to nomic modality, Tan's examples are de facto cases involving counter-nomics. Now, nomic contingentists cannot plausibly make the above identification because they need a *broader* notion of possibility than the nomic one in order to accommodate the interworld variation of nomic web. And it seems natural to them to identify that broad (perhaps maximal) objective possibility with *metaphysical* possibility. For those philosophers, laws of nature are (trivially) nomically necessary but metaphysically contingent. Given then that the identification of nomic with metaphysical modality can be made only by nomic necessitarians, it begs the question in the context of the present discussion and so it is better not to be used.

After this clarification, let me now proceed to the presentation of some examples of counter-nomic reasoning in scientific practice. First, counter-nomics are used in some scientific explanations in order to help scientists to determine the explanatory relevance of some factors and to reveal the relations (causation, realization, etc.) that support the explanations.[10] Tan (2019) describes cases where scientists appeal to subjunctive reasoning to explain the properties of macro-substances via their micro-structure. For instance, he discusses the case of the scientific explanation of diamond's poor conductivity via the covalent bonding between its atoms (2019, p. 40). This explanation invokes the subjunctive conditional "If diamond had

[10] Especially in Woodward's (2003) theory of scientific explanation, the very nature of explanation is to exhibit systematic relations of dependence expressed by subjunctive conditionals. Arguably, Woodward's theory should allow that some of those conditionals are counter-nomics.

not been covalently bonded, then it would have been a better electrical conductor" which, given essentialist assumptions about diamond's structure (that is, the assumption that nothing could —in the broadest sense— be a diamond without having the specific microstructure), is a *counter-possible* one. In other terms, the impossibility of the antecedent comes from the necessity of the Kripkean a posteriori identity "diamond=the substance having the microstructure X" which, in turn, flows from the necessity of the identity relation. Yet, one may find cases of scientific explanation in which the microstructure of substances depends on elements of the actual nomic web and so the conditionals involved can be plausible construed as counter-nomics. Consider, for instance, the case of salt. Bird points out that the sodium chloride (i.e., salt)

> is not simply a mixture of sodium and chlorine but is rather a compound where charged sodium and chlorine ions are held together in a crystal by the forces of electrostatic attraction—Coulomb forces…These Coulomb forces, the forces of electrostatic attraction, are precisely those governed by Coulomb's law. Hence the existence of salt entails not just the existence of sodium and chlorine ions but also of Coulomb's law or something very much like it (Bird, 2005, p. 535).

Given that, the subjunctive conditional "if salt had a different microstructure, then it would have failed to dissolve in water" involved in the scientific explanation of salt's solubility is a counter-nomic one.[11]

Another family of cases of scientific explanation related to counter-nomics are the ones involving fundamental constants. Appeal to the values of the latter is an indispensable part of the explanation that scientists give for a variety of facts. For instance, the size and structure of almost all composite objects of our universe (from nuclei to stars, and beyond stars to galaxies and galaxy clusters) are manifestations of the different possible equilibrium states between competing forces of nature the structure of which (states) is largely determined by the fundamental constants (for a comprehensive discussion, see Barrow and Tipler, 1986). In addition, fundamental features of the universe itself, such as its rate of expansion, the presence of galaxies within it and the very existence of life, are

[11] In fact, Bird (2005, pp. 538-539) argues that, given some empirical assumptions about the constitution of entities and the laws of nature, his example can be generalised for *all* substances. If that is true, then any scientific explanation of the properties of a substance that is based on its micro-structure involves a counter-nomic of some sort. For my purposes here, however, it suffices that one may find *some* cases of scientific explanation that involve counter-nomics.

dependent upon the values of certain fundamental constants (for details, see Rees, 1999). In some cases, the explanatory role of constants is revealed by invoking subjunctive conditionals having antecedents that contain laws in which fundamental constants (which current physics cannot fully determine) take on values that differ from the actual ones (Kim, 2009). Given the plausible assumption that if the constants appearing in the laws get different values the laws themselves have been changed, the above-mentioned conditionals are counter-nomics.

The second aspect of science that in some cases involves counter-nomics is the model-based reasoning. Motivated by reasons of simplification and mathematical tractability, scientists often make counterfactual idealised suppositions which in some cases are in fact counter-nomics because they violate elements of the actual nomic web. For example, when scientists study the motion of objects via models that include frictionless planes, they actually make a counter-nomic supposition because a surface without friction violates laws regarding intermolecular forces. Besides idealised models there is another case of scientific model-based reasoning that may implicitly involve counter-nomics. It is well-known that since our current best physical theories, the Standard Model of fundamental interactions and General Relativity, leave unanswered a number of theoretical questions, physicists are on the search of a quantum theory of gravity. Various models have been proposed and some of them can accommodate violations of elements of the actual nomic web. For instance, it can be shown that models of string theory, spacetime foam models and non-trivial spacetime topology models can accommodate violation of a core symmetry of the Standard Model, the CPT symmetry (for a brief discussion, see Lehnert, 2011). Hence, by thinking of those models as candidates for the correct fundamental theory, physicists are involved in counter-nomic reasoning. Prospective proponents of MN cannot challenge this upshot by arguing that, since scientists do not know *yet* what the actual nomic web is, it is not clear that their practice involves counter-nomic reasoning. For the results reached by the methodology of MN can only be based on our *current* best theories; no one knows what a *future* theory will say about the elements of the actual nomic web. And this holds even in situations (like the present one in physics) in which we *know* that our two best and mature theories cannot *both* be true for the fundamental level.

The third aspect of science that may involve counter-nomics is the multifaceted reasoning associated with the evaluation of theories. Tan (2019, p. 49) proposes that at least one aspect of that reasoning —the one related to the explanation of how we know that a particular past theory is false— involves the evaluation of counter-nomics. More precisely, Tan

argues that the relevant argumentation is of the form: "If the past theory had been true, we would observe specific phenomena. We do not observe those phenomena, so we know that the past theory is false", and the antecedent of the conditional, given the upshot of the whole reasoning, implicitly refers to a non-actual nomic web. Wilson (2021, p. 1117) generalizes Tan's point by giving examples in which the falsity of the theory is revealed by the lack of various of theory's consequences which are not necessarily observable. In addition, a similar kind of reasoning is sometimes used to increase the plausibility of an accepted theory given the observable facts. For example, assuming the truth of Newton's gravitational law and given that planets of the solar system follow closed orbits, the true counter-nomic "If the gravitational force had followed an inverse-cube law, planets would not follow closed orbits around the sun" (and many —in fact infinite— other conditionals that ascribe to gravitation a law that differs from the actual (according to the above assumption) inverse-square one) increase our confidence that Newton's law has the correct functional form[12]. Finally, Kimpton-Nye (2020, p. 522) points out that there are episodes of change of scientific theories in which scientists evaluated the truth-value of substantive, non-trivial counter-nomics. His example concerns Eddington's test of General Relativity. According to Kimpton-Nye, there is a counter-nomic supposition that supports Eddington's experiment: that if the correct law of gravity were Newton's gravitational law, then a beam of light passing through the sun's gravitational field would follow a curve of specific arc seconds.

The list of cases presented here is not meant to be exhaustive; the point is that in all the above-presented cases,[13] for counter-nomics to play the role scientists want them to play, they should have a *non-trivial* truth-value. That is, they could not *all* be true by definition because in such a case they were useless for scientists.[14] Given that, it seems then that

[12] Note that although *all* such counter-nomics are true, their truth-value is not evaluated in a trivial manner. It is rather a consequence of a theorem of classical mechanics (i.e., Bertrand's theorem) according to which among central-force potentials with bound orbits, there are only two types of central-force scalar potentials with the property that all bound orbits are also *closed* orbits: the radial harmonic oscillator potential and the potential corresponding to an inverse-square force.

[13] Another case in which scientists appeal to counter-nomics is described by Fletcher (2021) who points out that the widespread practice of physicists to use *variational principles* involves reference to nomic impossibilities. For a discussion about the modal implications of one of those principles (i.e., Hamilton's principle), see Livanios (2018).

[14] Tan (2019, p. 47) argues that the very practice of testing models involving counter-possibles against their physical targets shows that those subjunctive conditionals are at least apt for taking non-trivial truth-value.

the evaluation of their truth-value presupposes invoking possible worlds beyond those in which the actual nomic web holds, that is, nomically impossible ones. Hence, at least prima facie, to accommodate all those possibilities suggested by physical science, modal naturalists should allow the interworld variation of the actual nomic web and as a result presuppose (pace B&W) nomic contingentism.

Nomic necessitarians, however, have argued that, despite first appearances, their view is compatible with scientists' appeal to counter-nomics. There is a variety of responses to the difficulty arising from counter-nomics, ranging from approaches utilising embedded counterfactuals (Handfield, 2004) and meta-theoretic views that replace talk about possible worlds with talk about models of theories to error-theoretic and fictionalist ones (Kimpton-Nye, 2020).[15] The common aim of all those responses is, as Wilson explains, to show that

> we do not need to soberly judge hypothetical scenarios as objectively possible in order to investigate them and the prospective theories that characterize them. We can (and I think physicists, like mathematicians, do) adopt a noncommittal pretence of possibility for the sake of the argument. This provides us with a suitably deflationary picture of the counterpossibles involved in physical theory evaluation, and it disarms the threat that necessitarianism faces from the argument from physical theorizing (2021, p. 1121).

It is beyond the scope of the present paper to evaluate the efficiency of those responses. Suffice it to say that, in my view, Wilson (2021) himself provides a strong argument against all those responses. His argument from causal structure is in brief terms the following. First, he points out that counter-nomics are entailed by the causal structure posited by scientific theories. According to Wilson, this is evident in Woodward's interventionist approach but afflicts all the other views about causation which are intended to entail the interventionist counter-nomics. Nomic

[15] The strategy of the embedded counterfactuals approach is to embed the problematic counter-nomics within a suppositional contingentist context with respect to which they are no longer physically impossible. According to the meta-theoretic account, physical theorizing should be construed as thinking about models of theories, not about counter-nomics and nomically impossible worlds. In error theory, although scientists succeed in their theorizing by appealing to counter-nomics, there are in fact no counter-nomic modal facts. Finally, according to the fictionalist approach, when scientists evaluate counter-nomics, they do it pretending that their antecedents describe genuine possibilities. For details, see Wilson (2021, pp. 1119-1121).

necessitarianism, however, trivialises the interventionist counter-nomics and trivially true counter-nomics cannot help us to find the causal structure of the world. Given that, Wilson proceeds to show that, assuming the *objectivity* of the posited causal claims, the afore-mentioned entailment raises serious worries for all proposed responses to the counter-nomic difficulty for nomic necessitarianism. More precisely, Wilson points out that an embedded counterfactuals account makes causal claims true only relative to a supposition contrary to nomic necessitarianism itself (i.e, nomic contingentism), while a meta-theoretic approach captures only causal dependencies between models of theories, not causal dependencies in reality. Furthermore, he argues that error-theoretic and fictionalist accounts lead to views incompatible to the supposed objectivity of causal claims (that is, they lead to error theory and fictionalism about them, respectively). The upshot is that, in so far as there is no adequate solution to the problem, one cannot plausibly invoke nomic necessitarianism to undermine the epistemic relevance of counter-nomics to physical science.

Now, both descriptive and prescriptive modal naturalists agree that *in the actual world* the most reliable evidence for physical modal facts is given by the nomic web. Hence, given that a) an adequate solution to the counter-nomic difficulty requires the appeal to non-actual nomic webs and b) this appeal presupposes nomic contingentism, I conclude that MN cannot be neutral regarding the nomic necessitarianism vs nomic contingentism debate on pain of extensional inadequacy. This upshot stands in contrast to B&W's claim that "descriptive modal naturalism is compatible with any view of the modal status of the fundamental physical laws." (2024, p. 15). B&W think that the *reliability* of the actual nomic web as a source of evidence for modal knowledge does not depend on its modal status. I agree, but the issue here is not only the reliability but also the extensional correctness. As the difficulties for meeting the counter-nomic challenge show, only contingentist versions of MN can be extensionally adequate.

4. Is Nomic Contingentism MN-Friendly?

Even if modal naturalists get persuaded that nomic necessitarianism cannot provide a successful response to the counter-nomics challenge, they might worry that the adoption of nomic contingentism is not a MN-friendly solution because it brings back to the fore the modal *intuitions* that they want to exorcise. As a response, I would first point out that MN's commitment to science as the primary source of evidence does not justify a *radical* polemic against invoking intuitions. This is not only because MN

itself is not committed to the view that science should be the *exclusive* source of evidence; it is also because scientists themselves give in some cases extra weight to intuitions. Consider, for instance, the reasons behind physicists' reluctance to adopt the physical possibility of models of General Relativity with closed timelike curves (see Hawking's 1992 *chronology protection conjecture* that there must be a physical mechanism that forbids the creation of closed timelike curves in the universe although General Relativity allows it).

In any case, I suggest, modal naturalists may reduce the alleged problematic consequences of embracing nomic contingentism by insisting that the only legitimate counter-nomics are the ones whose antecedents refer to cases resulted by *modest* changes made on the elements of the actual nomic web and not to 'remote' scenarios in which *merely conceivable* properties appear in also alien, merely conceivable, laws having nothing to do with the actual ones. In such a manner, modal naturalists can *minimise* the impact of intuitions in modal reasoning despite the fact that they acknowledge an objective *metaphysical* modality. Especially for the case of possibilities, modal naturalists may embrace the view that the nomic impossibilities can be defined without invoking commonsense-based modal intuitions, but only with the help of the following notion of *weak compatibility*:

> A possibility is 'weakly' compatible with scientific findings about (and/or scientific practice based on truths concerning) the actual nomic web if it represents a case in which modest changes on the elements of the actual nomic web have been made.

Given the notion of 'weak' compatibility, modal naturalists can provide a definition of the set of *metaphysical* possibilities as the one that includes both nomic possibilities and those nomic impossibilities that are 'weakly' compatible with physical science.

Unfortunately, I cannot give here a precise definition of the notion of 'weak' compatibility with the actual nomic web. Nevertheless, the previous examples of counter-nomics give a 'flavour' of what I mean by a modest change on some elements of the actual nomic web and, consequently, clarify to a certain extent the concept of 'weak' compatibility. In addition to those examples, I suggest that the set of modest changes may also include cases where (a) only some of the elements of the actual nomic web hold, and/or (b) specific relations among elements of the actual nomic web do not exist. The general idea behind the appeal to the notion of 'weak' compatibility is that modal naturalists should allow possibilities that include modifications of

the elements and structure of the actual nomic web (for example, changes of the functional form of the actual nomic formulas, different values of the fundamental constants appearing in the actual laws, decrease of the number of elements of the actual nomic web or of the relations among them, etc.) but refuse to accept possibilities that posit alien properties or explicitly *add* to the actual nomic web alien elements and alien relations *merely* on the basis that we can *conceive* such additions.

Before turning in the next section to the discussion of a second issue related to MN, two points need to be stressed. First, given the (plausible, though not defended here) hypothesis that laws are not autonomous but are elements of a *web*, the fact that specific kinds of changes made on some elements (or some relations) of the actual nomic web are regarded modest does not exclude the case the resulting nomic web *as a whole* to be radically different from the actual one. In fact, it does not even exclude the possibility that because of changes we may reach a possible world having no nomic *web* at all. A change is characterised as modest by giving attention only to the impact on the individual nomic element(s) on which it is made.

The second point is about the nature of properties appearing in the counter-nomics. The suggestion that modal naturalists should not consider as potential evidence-providers counter-nomics that involve merely conceivable *alien* properties does not necessarily imply that scientists necessarily assume that the *same* properties can be included in non-actual nomic webs and, as a result, embrace a criterion of interworld identity of properties that is independent of the actual nomic web. Given that such a criterion is compatible with purely qualitative properties —or powerful qualities under certain interpretations— but not with pure powers,[16] this would be an undesired implication that would beg the question against dispositionalists. What *does* the suggestion imply is that, in the case in which the properties appearing in the counter-nomics are indeed alien, the scientific practice implicitly *constrains* their 'behaviour'; alien properties should 'behave' according to modestly modified elements of the actual nomic web.[17]

[16] Typically, the identity of pure powers is determined by their *actual* causal/nomic roles which, for some powers theorists, 'flow' from the dispositional essence of powers. For pure powers theorists then there are no possible worlds in which the behaviour of the actual properties is associated with alien laws.

[17] Two points of clarification: first, what I call here the 'behaviour' of a property is its nomic role at a world in which it exists. Second, we should not interpret the expression "the alien properties should behave according to..." as being compatible only with a *governing* approach to laws.

5. On the Asymmetries between Possibilities and Necessities in the Context of MN

In the previous section I suggested that in order to define a science-based metaphysical possibility, one does not *need* to talk about possible worlds with different fundamental properties from the actual world. One may start from the actual fundamental properties and consider possible worlds with different nomic webs, provided that those webs have resulted by what I call modest changes in the actual web. Hence, although a kind of alien-properties-based metaphysical possibility is open to the metaphysician, it is not mandatory for the modal naturalist to appeal to alien features to define an autonomous metaphysical possibility. This is a pleasing result for modal naturalists because in any case they wish to minimise the appeal to modal intuitions, and it is through the latter that one would most probably justify the postulation of alien properties. The case for the minimal postulation of alien properties in the context of MN can also be made (perhaps more strongly) when we take into account metaphysical *necessities*. For, by definition, any candidate for a metaphysically necessary claim should hold in all possible worlds, irrespective of whether they are inhabited by actual or alien properties. And it is difficult to see what *scientific* reasons might support the claim that an actual truth should hold in possible worlds inhabited (only or also) by alien properties.[18]

Although considerations from both possibilities and necessities yield the same conclusion regarding the postulation of alien properties, B&W argue that there is an interesting asymmetry between possibility and necessity in the context of MN, an asymmetry that would make any prospective advocate of MN to favour nomic necessitarianism over nomic contingentism. To illustrate that, they first argue that a nomic contingentist version of MN sets limits to the knowledge of robust objective necessities:

> […] coupling descriptive modal naturalism with contingentism entails that we have no direct path to knowledge of metaphysical necessities. The contingentist can't simply point to the laws of physics and get metaphysical necessities for free, as can her necessitarian counterpart (i.e. her counterpart who believes the fundamental physical laws are metaphysically necessary). When science tells us, for example, that

[18] One might object that Bird's (2005) arguments show that there can be scientific reasons for holding metaphysically necessary claims associated with non-fundamental laws. Yet, his argumentation involves only actual properties and, in any case, cannot prove that we may have scientific reasons for holding necessary truths for *fundamental* properties.

> nothing can travel faster than light, contingentism entails that it has acquainted us with a mere physical necessity. For the contingentist modal naturalist, science can inform us of metaphysical necessities only indirectly, in virtue of logical inferences from the possibilities of which science does inform us (2024, p.15).

Contingentist modal naturalists can at best have a knowledge of 'thin' necessities, *parasitic* to the direct knowledge of robust objective possibilities:

> Possibility and necessity are generally regarded as duals: when one finds out that P is possible, one finds out that it is not the case that not-P is necessary. So all of the discoveries of possibilities highlighted in the previous section are ipso facto discoveries that certain necessities do not hold. For example, the empirical evidence in favour of general relativity, which has convinced most observers that it is possible that spacetime be curved, counts equally as evidence that it is not necessary that spacetime be flat. In addition, assuming S5 modal logic, any discoveries of possibilities are ipso facto discoveries of necessities, since possibility claims are themselves necessary (2024, p. 54).

Given all that, the examples of robust necessities that B&W provide are not controversial only assuming nomic necessitarianism. This creates the following asymmetry:

> Our cases of discoveries of possibility can support modal naturalism regardless of the modal status of the laws of nature. Our cases of discoveries of impossibility, however, tend to support modal naturalism only if the fundamental laws of nature are non-contingent (2024, p.16).

I have argued in Section 3 that in order to be extensionally adequate about possibilities, MN cannot be neutral regarding the modal status of laws. Hence, contrary to what B&W claim, it is not the case that modal naturalists can be neutral regarding the revealing of possibilities but not of necessities. It might be suggested, however, that proponents of MN should nonetheless favour nomic necessitarianism over nomic contingentism because only in a nomic necessitarianist context they can give convincing examples of robust (that is, non-parasitic to known genuine possibilities) necessities.

In response, I would say that, pace the last claim, those who embrace a nomic contingentist version of MN can discover robust objective necessities

by appealing to sources which are not *directly* related to the actual nomic web but nonetheless involve scientific findings. Characteristic examples are cases of Kripkean a posteriori identities (such as that water is H_2O) which are revealed by scientific methods, but their necessity is related to essential features of identity. It might be objected that these examples are not MN-friendly because modal naturalists are not entitled to appeal to a priori sources of necessity. This is not a strong objection, however, because, as we noted previously in Section 2, B&W themselves hold that the most plausible versions of MN are *non-uniformist*. Furthermore, embracing uniformism in this context would implicitly beg the question against nomic contingentists. For, an uniformist version of MN entails prescriptive MN and, as B&W (2024, p.16) explain, prescriptive MN and modal necessitarianism form a potentially attractive package. Hence, given that modal naturalists would surely not want to beg the question against nomic contingentism by embracing a view that favours nomic necessitarianism, they should include cases of Kripkean necessities in the set of available MN-friendly sources for revealing modal facts.

Finally, it might also be objected that, Kripkean necessities notwithstanding, there is an asymmetry lurking here because, in contrast to the necessitarian version, the contingentist version of MN cannot uncover metaphysical necessities regarding *fundamental laws*.[19] This asymmetry, however, does not raise an objection to contingentist forms of MN because according to nomic contingentism there are *no* metaphysical necessities regarding fundamental laws in the first place. Hence, any objection from the inability of the contingentist version of MN to reveal such alleged metaphysical necessities simply beg the question against it.

6. Concluding Remarks

B&W argue that modal naturalists cannot be neutral regarding the nomic necessitarianism vs nomic contingentism debate. Rather they should follow the necessitarian view because it is only in that way they can provide convincing examples of objective broad (metaphysical) necessities in nature. In this paper, I argued that various cases of non-trivial counter-nomic reasoning in science strongly suggest that modal naturalists should accept objective counter-nomic possibilities that according to Wilson's (2021) own view cannot be plausibly accommodated by nomic necessitarianism. Hence,

[19] Arguably, we can have evidence for *non-fundamental* nomic necessities in the context of MN (see again Bird's 2005 example of salt and the nomic necessity that salt dissolves in water).

although I agree with B&W that modal naturalists should take sides in the debate regarding the modal status of laws of nature, I defended (pace them) the view that nomic contingentism should be the preferred view of modal naturalists. In addition, to the worry that nomic contingentism could in principle bring back to the fore modal intuitions as sources of modal knowledge, I responded by proposing a MN-friendly definition of metaphysical possibility that minimises the evidential role of intuitions. Finally, my reply to the accusation that nomic contingentism raises (within the context of MN) epistemic asymmetries between possibilities and necessities is that modal naturalists who embrace contingentism can provide knowledge of robust (non-parasitic to possibilities) objective metaphysical necessities but, on pain of refuting their own view, those necessities cannot be about fundamental nomic facts.

References

Armstrong, D. (1983). *What is a law of nature?* Cambridge University Press.

Barrow, J., & Tipler, F. (1986). *The anthropic cosmological principle*. Clarendon Press.

Bird, A. (2005). Unexpected a posteriori necessary laws of nature. *Australasian Journal of Philosophy, 83*(4), 533-548.

Blackburn, S. (1993). Morals and modals. In *Essays in quasi-realism* (pp. 52-74). Oxford University Press.

Bostock, S. (2003). Are all possible laws actual laws? *Australasian Journal of Philosophy, 81*(4), 517-533.

Bryant, A., & Wilson, A. (2024). *Modal naturalism: Science and the modal facts*. Cambridge University Press.

Emery, N. (2023). *Naturalism beyond the limits of science: How scientific methodology can and should shape philosophical theorizing*. Oxford University Press.

Fletcher, S. (2021). Modality in physics. In O. Bueno & S. Shalkowski (Eds.), *The Routledge handbook of modality* (pp. 251-264). Routledge.

Grüne-Yanoff, T. (2009). Learning from minimal economic models. *Erkenntnis, 70*(1), 81-99.

Handfield, T. (2004). Counterlegals and necessary laws. *Philosophical Quarterly, 54*(216), 402-419.

Hawking, S. W. (1992). Chronology protection conjecture. *Physical Review* D, *46*(2), 603-611.

Hireche, S., Linnemann, N., Michels, R., & Vogt, L. (2021). The modal status of the laws of nature: Tahko's hybrid view and the kinematical/dynamical distinction. *European Journal for Philosophy of Science, 11*, 1-15.

Kim, S. (2009). Counterlegals and the 'makes no difference' argument. *Erkenntnis, 70*(3), 419-426.

Kimpton-Nye, S. (2020). Necessary laws and the problem of counterlegals. *Philosophy of Science, 87*(3), 518–35.

Kimpton-Nye, S. (2022). Laws of nature: Necessary and contingent. *The Philosophical Quarterly, 72*(4), 875-895.

Lehnert, R. (2011). Violations of Einstein's relativity: Motivations, theory, and phenomenology. *AIP Conference Proceedings, 1361*, 30-43.

Lewis, D. (1994). Humean supervenience debugged. *Mind, 103*(412), 473-491.

Livanios, V. (2017). *Science in metaphysics*. Palgrave Macmillan

Livanios, V. (2018). Hamilton's principle and dispositional essentialism: Friends or foes? *Journal for General Philosophy of Science, 49*(1), 59-71.

Livanios, V. (2019). Vikingism as a meta-metaphysical thesis. *Metaphilosophy, 50*(4), 516-535.

Massimi, M. (2019). Two kinds of exploratory models. *Philosophy of Science, 86*(5), 869-881.

Quine, W.V.O. (1976).Three grades of modal involvement. In *The ways of paradox, and other essays* (pp. 156-174). Harvard University Press.

Rees, M. (1999). *Just six numbers*. Basic Books.

Sidelle, A. (1989). *Necessity, essence, and individuation: A defense of conventionalism*. Cornell University Press.

Tahko, T. E. (2015). The modal status of laws: In defence of a hybrid view. *Philosophical Quarterly, 65*(260), 509-528.

Tan, P. (2019). Counterpossible non-vacuity in scientific practice. *The Journal of Philosophy*, *116*(1), 32-60.

Waters, K. (2017). No general structure. In M. H. Slater & Z. Yudell (Eds.), *Metaphysics and the philosophy of science: New essays* (pp. 81-108). Oxford University Press.

Williamson, T. (2018). Spaces of possibility. *Royal Institute of Philosophy Supplements, 82*, 189- 204.

Wilson, A. (2020). *The nature of contingency: Quantum physics as modal realism*.Oxford University Press.

Wilson, A. (2021). Counter-possible reasoning in physics. *Philosophy of Science, 88*, 1113-1124.

Wilson, A. (2024). Four grades of modal naturalism. *Proceedings of the Aristotelian Society, 124*(2), 115-137.

Wirling, Y. S., & Grüne-Yanoff, T. (2025). Through the prism of modal epistemology: Perspectives on modal modeling. In T. Knuutilla, T. Grüne-Yanoff, R. Koskinen & Y. S. Wirling (Eds.), *Modeling*

the possible: Perspectives from Philosophy of Science (pp. 27-47). Routledge.

Woodward, J. (2003). *Making things happen: A theory of causal explanation*. Oxford University Press.

Received 21st February 2025; accepted 2nd April 2025.