



# Methodological Naturalism, Analyzed

Miles K. Donahue<sup>1</sup> 

Received: 20 May 2023 / Accepted: 19 January 2024  
© The Author(s) 2024, corrected publication 2024

## Abstract

I present and evaluate three interpretations of methodological naturalism (MN), the principle that scientific explanations may only appeal to natural phenomena: as an essential feature of science, as a provisional guideline grounded in the historical failure of supernatural hypotheses, and as a synthesis of these two approaches. In doing so, I provide both a synoptic overview of current scholarship on MN, as well a contribution to that discussion by arguing in favor of a restricted version of MN, placing it on a firmer theoretical foundation than that supplied by previous studies, and replying to recent objections.

## 1 Introduction

Could a scientist, acting in good faith to their methodology, ever propose that some event happened because God brought it about? More generally, consider the following claims:

1. God caused the Big Bang.
2. My erratic behavior is the unfortunate result of demon possession.
3. I am sick with pneumonia because the spirits of my ancestors are punishing me.
4. Near-death experiences involve a person's soul leaving their body.
5. An intelligent mind designed the *bacterial flagellum* found in biological organisms.

Our question is simple: could any of these assertions ever qualify as scientific hypotheses? And if not, why not? That question sharpens the focus to one issue, methodological naturalism (MN): *the stipulation within a domain of study to offer explanations*

---

✉ Miles K. Donahue  
miles.donahue@stx.ox.ac.uk

<sup>1</sup> St. Cross College, University of Oxford, 61 St. Giles' Street, Oxford OX1 3LZ, UK

*only in terms of natural phenomena.*<sup>1</sup> One might reasonably think that many disciplines, from history to psychology to economics, take MN as a ground rule, but my concern is with the claim that the natural sciences are so-committed: instead of calling upon the supernatural to do explanatory work, physics, biology, and chemistry may only appeal to the spatiotemporal world of matter and energy – or more simply, to nature. On this understanding, science does not entail that supernatural entities do not exist (a stronger thesis known as ‘metaphysical’ or ‘ontological’ naturalism), but simply that if they do exist, they can play no role in scientific theorizing.

Though discussion about MN is largely confined to philosophers of religion,<sup>2</sup> a wide range of philosophers will find reflection on that debate worth the effort. Even for those who take it as obvious that scientific practice requires MN, spelling out the details of *why* that is so is far from easy. I will show that undertaking that task engages one with fascinating problems related to the scientific method, inference to the best explanation, the history of science, the relationship between science and philosophy, and even the fine-tuning of the universe for intelligent life. It is a topic as worthy of careful philosophical attention as any other.

While current scholarship includes excellent examinations of specific issues related to MN, there is at present no systematic treatment of a broader range of the questions that MN raises. The present paper fills that gap by bringing together the threads of a wide breadth of publications on the topic, thereby clarifying the structure of the arguments offered for and against MN and providing a roadmap of current scholarship. In that process, I argue for a restricted version of MN and respond to recent objections.

In Sect. 2, I define key terms and outline three interpretations of MN defended today: unrestricted, provisional, and restricted. In Sect. 3, I explore the first view: MN is an essential feature of science and our only means for studying the natural world. Here I look at both semantic and conceptual arguments for MN. In Sect. 4, I consider the second interpretation: science, though compatible with supernatural explanations in principle, nevertheless justifiably ignores them in practice. I examine four instances of natural theories replacing supernatural ones in the history of science: Newton’s musings about planetary orbits, vitalism, creation science, and the theory of evolution. In Sect. 5, I argue that a synthesis of these two strands, the third view, is plausible: MN, though essential to science, has to justify its *applicability* to any given aspect of the natural world.<sup>3</sup>

<sup>1</sup> This characterization of MN is fairly standard; see Larmer (2022, p. 101), Torrance (2017, p. 692) and Applegate (2013, p. 37).

<sup>2</sup> In his extended discussion of naturalism, Papineau (2021), after briefly mentioning MN as defined above, writes rather tersely that “this kind of ‘methodological naturalism’ will not be discussed further here” (Sect. 2.1), with Mayes (n.d.) reporting that MN “is uncontroversial within the philosophy of science” (Sect. 4.e).

<sup>3</sup> Although Kojonen (2017) provides an eloquent argument for the same thesis, his case more or less *assumes* that MN is essential to science, writing only that we ought to preserve MN so that science’s “basic features are more easily defined and the difference between personal explanations and natural science is maintained” (p. 345). In fairness, his argument may be purely conditional: *if* we think that MN is essential to science, the best way of construing MN is in a restricted way. I, then, will argue for the unconditional version of that claim.

## 2 Defining Terms

### 2.1 Natural, Supernatural, and God

We will immediately want to sort out what ‘natural’ and ‘supernatural’ mean if we want to understand what restrictions MN places on scientific practice. Unfortunately, defining these terms is both difficult and controversial. In particular, some argue that there is *no* consistent definition of ‘natural’ used throughout science’s history (Halvorson, 2016, p. 141). For instance, the neutrino lacked both mass and extension when Enrico Fermi first theorized about it in 1934, making it unlikely that any scientist working in the eighteenth century would have called it a ‘natural’ particle (Dawes, 2011, p. 14). And yet, today’s scientists have no problem recognizing it as a tried and true constituent of nature. Boucher (2020) presses this objection in the form of Hempel’s dilemma: if we accept the commonsense connection between ‘natural’ and ‘physical,’ then we can say that to be *physical* (and therefore natural) is to feature in any theory of (a) contemporary physics, or (b) a complete, future physics. Either option, however, fails to square with the physicality of past paradigms of physics. By the lights of either (a) or (b), however, one would be forced to say that the plumb pudding atom, luminiferous ether, impetus, and caloric are by definition non-physical. But that seems wrong: even if these things do not exist, they still belong to the category of possible *physical* realities. As such, it seems there is no way to draw the lines of distinction between physical and non-physical, natural and non-natural.

The critical problem with this family of arguments is that there is no obvious reason we need a definition of ‘natural’ or ‘supernatural’ to understand in broad outline what these terms signify (Oppy, [Forthcoming](#), Sect. 8). For consider: knowledge, causation, justification, personhood, goodness, rightness, and even science itself resist our best efforts to capture them in a definition; even so, we all have a rough and ready understanding of their intended meaning. Often in philosophy and life, the best we can do is offer paradigm cases for a concept rather than an airtight set of necessary and sufficient conditions. Some paradigm instances of natural objects: chairs, tables, sunsets, galaxies, atoms, polar bears, the force of gravity, and generally anything spatio-temporal. With Oppy, we can think of ‘spacio-temporality’ as an *approximately* correct analysis of naturalness, much as ‘justified true belief’ is an approximately correct characterization of knowledge, Gettier-type counterexamples notwithstanding. In particular, we do not need to identify naturalism with “a microphysicalist conception... in which the whole of [nature] is reducible to some set of microscopic constituents whose physical properties are arranged according to universal laws” (Simpson, 2021, pp. 21–22), even if Boucher might be guilty of this identification. Instead, we can leave the door open as widely as possible for different metaphysical conceptions of nature, from reductive physicalism to Platonism to neo-Aristotelianism, precisely because on any of these proposals, the paradigms mentioned here still fall under the ‘natural’ umbrella. We can therefore pursue a rigorous discussion about MN’s merits while leaving it an open question how we might further flesh-out what it means to be a natural thing.

Feser (2021) defends an Aristotelian-Thomistic view that construes ‘nature’ and ‘natural’ in a very broad way, where the former encompasses anything that contains

its own principle of rest and motion, and the latter refers to anything that proceeds from a thing's nature or essence (this usage of the term comports with the sense in which we contrast 'natural' with 'artificial'). I have no desire to gatekeep the 'true' meaning of terminology, so I think it perfectly sufficient to say that MN concerns nature in the *narrow* sense, while an Aristotelian-Thomistic view analyses nature in the *broad* sense.

I understand 'supernatural' to refer predominantly to God, angels, demons, ghosts, spirits, and generally anything we might describe as both non-physical and personal (Fales, 2013, p. 248). MN asserts, then, that there is something scientifically illegitimate about appealing to these kinds of entities. And of course, so long as we have a basic understanding of what the term 'natural' in the narrow sense picks out in the world, what we choose to label phenomena outside that scope is not critical, whether 'supernatural,' 'preternatural,' or simply, 'non-natural.'<sup>4</sup> There are undoubtedly vague cases that do not fall cleanly into either category (e.g., are abstract objects, if they exist, 'natural'?), but that ambiguity notwithstanding, there are examples that do fall squarely into either camp – and that is enough to ground an examination of MN.<sup>5</sup>

Finally, although I often refer to 'God' in the context of arguments for MN, in what follows I am not making any particular theological or religious assumptions. Instead, focus on God as defined in the Judeo-Christian-Islamic tradition, usually understood as "a person without a body...who necessarily is eternal, perfectly free, omnipotent, omniscient, perfectly good, and the creator of all things" (Swinburne, 2004, p. 7), serves a heuristic function: if a particular argument for MN fails to exclude explanatory appeals to God, a supernatural entity if there ever was one, then the argument fails, period, regardless of what it might imply about *other* supernatural theories or explanations.

## 2.2 Varieties of MN

Focusing on the structure of scientific reasoning, is MN essential to that structure, in the way that *having four sides* is essential to being a square, or is it merely tacked on as something of a guideline? Following the work of Boudry et al. (2010), one may label the two answers to that question as intrinsic vs. provisional methodological naturalism, respectively:

INTRINSIC:	MN is a necessary condition for a theory to qualify as scientific.
PROVISIONAL:	MN is a useful guideline grounded in the past failure of supernatural explanations of the natural world.

<sup>4</sup> Feser (2021, p. 352) prefers to characterize angelic and demonic activity as *preternatural* because such entities themselves are still natural in the broad, Thomistic sense.

<sup>5</sup> Boucher (2020) has little regard for anchoring (super-)naturalness in paradigm cases, arguing that it fails to appreciate that his argument demonstrates that "the distinction between the physical and the nonphysical cannot be drawn in *any* satisfactory way" from which "it will follow that those intuitive judgments about what is and isn't physical are not valid" (pp. 66–67). But notice, we find ourselves in the exact same situation concerning knowledge, causation, goodness, science, and so on. For instance, we do not seem able to draw the lines of distinction between science and non-science in *any* satisfactory way (Laudan, 1983). Should we claim that 'science' is a meaningless concept? I think not.

To illustrate the difference, consider the perpetual motion machine. These are hypothetical devices that continue producing work forever without sapping energy from the surrounding environment. Today, scientists by and large ignore claims to have crafted them, much as (most of them) ignore the arguments of flat earthers. Why? It is not as though science is intrinsically barred from considering the existence of these machines (or of a flat earth, for that matter), but simply that, over the course of history, every attempt to make one has failed. Correspondingly, evidence for the first and second laws of thermodynamics – laws that prohibit perpetual motion – has grown. So, scientists, reasoning inductively from past experience, may be said to adopt a provisional, ‘There are no perpetual motion machines,’ as a guideline in determining which hypotheses do and do not deserve serious consideration.<sup>6</sup>PROVISIONAL proposes that supernatural hypotheses are rejected from respectable scientific discussion for the same reason: they have failed in the past, so we can ignore them today.

By contrast, take the idea that one is a brain in a vat being deceived by a mad scientist into thinking that an external world exists. Arguably, science simply ignores this hypothesis because its methodology is incapable of evaluating it. INTRINSIC proposes that supernatural theories are similarly outside the scope of scientific evaluation.

Moreover, INTRINSIC itself is subject to two interpretations depending upon how one construes MN’s domain of application:

UNRESTRICTED:	MN is an intrinsic feature of science and the only methodology by which one can gain knowledge about the natural world.
RESTRICTED:	MN is an intrinsic feature of science but restricted to those aspects of nature where natural explanations have historically proven fruitful.

UNRESTRICTED corresponds to what McMullins (2011) calls ‘strong methodological naturalism,’ and RESTRICTED is coextensive with Kojonen’s (2017) ‘intrinsic, provisional MN’ and what McMullins (2011) labels as ‘QMN<sub>2</sub>’

The distinction here is between two ways one might establish the limits of MN’s explanatory reach: *a priori* vs. *a posteriori* considerations, respectively. That point will become clearer as we explore these views below.

Given that RESTRICTED is most naturally taken as a synthesis of UNRESTRICTED and PROVISIONAL, in what follows I will assess the case for an unrestricted, provisional, and restricted MN in that order.

### 3 Unrestricted Methodological Naturalism

UNRESTRICTED claims that MN is (1) an essential feature of science, and (2) the only possible source of knowledge for facts about the natural world. In assessing this proposal, I will treat each claim in turn.

<sup>6</sup> An illustration inspired by Boudry et al. (2010, p. 235).

### 3.1 Is MN Intrinsic to Science?

Many philosophers argue that the very idea of explaining something via the supernatural is intrinsically unscientific (Forrest, 2000; Gregory, 2008; Halvorson, 2016; Mahner, 2012; Pennock, 2001, 2007, 2009; Ruse, 1982, 1994, 2001; Scott, 1998). They argue their case in two ways: appealing to the proper definition of ‘science’ and pointing to conceptual problems with explanations that invoke the supernatural.

#### 3.1.1 True by Definition?

Ruse (1982) writes that science by definition only deals with “the natural, the repeatable, that which is governed by law” (p. 322). This definitional argument has proven enormously influential in the U.S. legal system. The judge in *Kitzmiller v. Dover Area School District* ruled that intelligent design theory specifically could play no part in a science curriculum because science can only appeal to natural explanations “by definition and by convention” (2005, p. 736). The implication is that MN is part of what ‘science’ means, a point echoed by Forrest (2000) and Gregory (2008).

This quick and simple semantic argument for MN is unpersuasive. If one can justify hypotheses involving God or the supernatural on empirical grounds, then, in Sober’s (2011, p. 366) memorable turn of phrase, whether one calls that project ‘science’ or ‘shcience’ does not matter. A rose by any other name is just as sweet, after all. The fundamental problem with semantic arguments is that there must be some underlying reason for defining science one way or another, in the absence of which any move to define MN into science will be arbitrary. A stronger defense of MN, therefore, is to appeal to conceptual issues with supernatural hypotheses that render them incompatible with scientific methodology broadly understood – to argue, in Smith (2017)’s words, that “certain logico-epistemological features of supernatural explanations...put them beyond the purview of science” (p. 323). In such a case, the definition itself is not what matters, but the underlying rationale that justifies the definition.

#### 3.1.2 Laws of Nature

This point takes us into the second line of defense offered for INTRINSIC. Ruse identifies two other features that (ostensibly) disqualify the supernatural: regularity and governance by natural law. Although he does not provide much detail on the argument here, a plausible place to begin is with Pennock’s (2001) claim that scientists proceed in their work by the two-step process of observing regularities in the world and then generalizing those observations into laws, a methodology that excludes the supernatural. Why? Simply because “to say that some power is supernatural is, by definition, to say that it can violate natural laws” (p. 88). Similarly, Ruse (1994) writes that “[b]y ‘scientific methodology’...I mean a commitment to the idea of the world being law-bound – that is, subject to unbroken regularity” (p. 21). The implication is that the way scientists explain the world is incongruent with anything of the form ‘x happened because God willed it to be.’ Halvorson (2016) points to mathematical modeling in addition to natural law statements as examples

of the “general schemata” or inference patterns that proper science follows (p. 137), a method of inference that is simply different from appealing to agency in general, much less *supernatural* agency.

It is undoubtedly true that a central goal of science is to uncover laws behind otherwise disparate natural processes. But the question is not whether scientists do in fact explain the world in terms of laws, but whether they must. Answering that latter question requires assessing the so-called deductive-nomological (DN) characterization of scientific explanation, where *all* scientific explanations ultimately appeal to a law of nature (Woodward & Ross, 2021, Sect. 2.1; Okasha, 2016, pp. 37–44):  $x$  happens because  $x$  is an instance of natural law  $y$ . Pennock, Ruse, and Halvorson’s argument, then, rests on two assumptions: (1) that DN excludes supernatural appeals, but more importantly, (2) that DN is essential to scientific theorizing. If we step back and examine the broader logic of scientific inferences, however, (2) is not obviously true.

One can make this point by considering a widely established form of inductive reasoning: inference to the best explanation (IBE). In that vein, Draper (2005) points out that philosophers of science often distinguish between historical and nomological science. The latter deals with the generalized study of nature’s behavior at any point in time (e.g., how do gases behave under ideal conditions?), while the former attempts to explain specific features of nature by referring to past events (e.g., how did the continents assume their present position?). While appeal to natural law dominates in nomological science, it is not the only legitimate type of explanation in historical science. In that latter realm, one judges hypotheses instead “on the basis of their simplicity, their fit with general background knowledge about the world, and their ability to explain specific known facts” (p. 290). The logic of justification here is IBE, and “it is widely agreed that IBE is a legitimate mode of inference which plays a crucial role” in science (Clarke, 2009, p. 131).

With Lipton (2004), we can say that IBE warrants inference to the explanation “which would, if correct, be the most explanatory or provide the most understanding” (p. 59), a criterion Lipton calls ‘loveliness.’ Now, plenty of clearly ridiculous hypotheses would, if *true*, provide remarkable insight into a range of phenomena, so we must balance considerations of loveliness with those of *initial plausibility*, with Henderson (2014) explaining that “[e]ither the hypothesis should explain the data better...or it should be initially more plausible, or both” (p. 699). The crucial point is that it certainly appears that one can evaluate a hypothesis by the criteria of explanatory power, simplicity, plausibility, and so on even if that hypothesis is not an appeal to a law of nature or, as Halvorson maintains, a mathematical model. If that is the case, why must a scientist restrict their attention to natural hypotheses, particularly in the historical sciences? One could maintain that they just do as a brute fact adhere to this limitation, but that answer is less than satisfying.

### 3.1.3 Empiricism and Tractability

The most plausible move for a defender of INTRINSIC would be to concede that applicability to IBE is a necessary condition for a hypothesis to count as scientific in this context but maintain that it is not a sufficient one. What else might be required? Perry and Ritchie (2018, p. 1073) claim that science is committed to empiricism,



a point Poe and Mytyk (2007, p. 214) make as well: science is limited to what we can come to know by way of our senses, and supernatural realities are by definition not knowable in this way. Now, this objection will have to be parsed out carefully, because science routinely appeals to entities that we do not have direct observations of: virtual particles, black holes, curled up spatial dimensions, imaginary time, multiple universes, and so on.

But there is a more subtle way of framing the argument. Waller (2019) reasonably suggests that “we can distinguish scientific from metaphysical claims by means of their respective methods of justification. Generally speaking, we can call a claim ‘scientific’ if its justification is predominantly empirical” (p. 66). The relevant factor is thus not whether an entity itself is accessible to the senses, but whether one can use empirical means to theorize about it. As a hypothesis admits of less and less empirical evaluation and relies more and more on a methodology common in metaphysics for its proper assessment – roughly, a process of rational, careful reflection aimed at drawing out conceptual implications at the level of thought rather than experimentation – we move away from the domain of what is amenable to scientific evaluation.

What does this imply for the supernatural? Below I will consider hypothetical ‘spectacular’ evidence for the supernatural (Fig. 2). For the moment, I note that the chain of reasoning connecting that evidence to its corresponding supernatural explanation is more plausibly construed as philosophical than scientific because an implicit premise in that inference is something of the form, “this body of evidence is more probable on the theistic hypothesis than on the naturalistic one.” After all, if the evidence were *not* more probable given theism than given naturalism, then it would not be *evidence* for theism in the first place. But how do we justify that premise? Through observations of God and His proclivities? Through experimentation of any kind? Surely not. That justification will instead involve non-empirical, philosophical reflection upon the nature of God, what one might characterize as a basic appeal to intuition that is fundamentally distinct to the way scientists support their theories.

In a similar vein, Collins (2016) points to what he calls ‘tractability’ as that criterion that disqualifies supernatural theories as scientific: tractable theories explain the world by referencing factors that one can analyze and understand through other branches of science, and for that reason, such theories provide a detailed explanation of the relevant phenomena. The Big Bang theory is tractable in this sense because “the postulated ‘fireball’ that resulted in our current universe provides a detailed explanation [insofar as] we can use particle physics to elaborate this fireball’s internal dynamics” (p. 11). By contrast, theories that reference an immaterial ‘life force’ or a God that adjusts planetary orbits (discussed below) are not tractable because science cannot investigate either’s internal structure. Both hypotheses lack the *depth of explanatory insight* that explanations in science ought to offer, and an “explanation’s right to be called ‘scientific’ is, indeed, in considerable part earned precisely by its ability to provide such detail” (Narveson, 2003, p. 94). It seems to me that the preference for natural law inferences or mathematical modeling reflects precisely this quest for sufficient granularity in one’s explanations.

One might object that intentional or personal explanations have depth and detail in their own right. If I ask why the glass fell and shattered, I could answer by citing its initial velocity in conjunction with Newton’s laws of motion and a description



of the rigidity of the floor (a nomological explanation), or I could cite the fact that my nephew has a penchant for curiosity and wanted to see what would happen if he smacked the glass off the counter (an intentional one). It is certainly true that explanations in terms of an agent and their reasons for performing some action provide insight that nomological explanations do not, and that the two are complimentary explanations for the phenomena to which they both apply. But what supernatural theories ask us to accept is an intentional explanation in the absence of any possible nomological one. They might explain why something happened, but not how, and that explanatory gap is what disqualifies them from a scientific vantage point.

Now clearly, in many purported cases of God's miraculous activity, there will be *some* aspects of these phenomena amenable to scientific investigation. Were a modern-day chemist to have observed Jesus' turning water into wine under a microscope, for instance, they may well have seen an instantaneous fermentation (Perry & Ritchie, 2018, p. 1074). One might even think that divine intervention is not appreciably different from human intervention in the natural world.<sup>7</sup> The difference, however, is that in the case of human agents interacting with the world, we have detailed, tractable explanations about the *means by which* they interact with their environment: neurons fire in the brain, muscles contract in a certain way and exert a force greater than the gravitational force pulling down on objects, and so on. When God parts the Red Sea or creates the universe from nothing, by contrast, there is no tractable explanation about how God manages to do these things. That does not mean that God could not do them, but simply that such events are outside the scope of scientific analysis. In other words, even if certain instances of miraculous activity admit of a degree of tractable analysis – e.g., Jesus turning water into wine – it is plausibly not nearly enough to qualify the relevant supernatural explanation as scientific.

These arguments are on the right track. The upshot, however, is that one can only conclude to a qualified INTRINSIC, one that prohibits scientific consideration only of those supernatural hypotheses that (a) require largely non-empirical means to assess them or (b) fail to offer tractable, detailed explanations. There is no guarantee that such a qualified principle will successfully section science off from all possible supernatural explanatory appeals. Lest one worry that MN threatens to suffer death by a thousand qualifications at this point, an important implication of this analysis is that explanatory appeals to God as discussed in philosophy of religion today, as well as any appeal to a supernatural agent in general, will fall outside the purview of science. We might then speak about a methodological *non-theism* rather than methodological *naturalism* writ large. Beyond that, whether a particular supernatural theory is empirically grounded or tractable enough to qualify as 'possibly scientific' will have to be decided on a case by case basis.

### 3.2 Is MN Our Only Means for Investigating the Natural World?

Even with INTRINSIC in place, one might just go ahead and, utilizing methods like IBE, theorize about the supernatural and its interaction with the natural world, merely swapping the label 'metaphysics' for 'science.' Is this move problematic?

<sup>7</sup> Thank you to an anonymous reviewer for pressing me on this point.

That question brings us to the second tenant of UNRESTRICTED: appeal to non-natural hypotheses could never illuminate our understanding of the natural world. As such, we can conclude that MN is the only game in town on a purely *a priori* basis. Why think this? The issue seems to be that supernatural hypotheses are intrinsically defective in some way, to the extent that they cannot be assessed via IBE or any other commonly accepted form of rational inference. Even if we attempt to bypass MN and evaluate a supernatural hypothesis via IBE in our quest to understand nature, still the supernatural does not meet this very general condition. Consider three such arguments.

### 3.2.1 Predicting Nothing

Pennock (2001) argues that “[s]ince there are no known constraints upon processes that transcend natural laws, a supernatural agent or force could be called upon to ‘explain’ any event in any circumstance,” adding that “because such a hypothesis neither makes any specific or general predictions nor rules out any possibility, no observation could count for or against it; it is in principle untestable” (p. 318). The issue, then, is that supernatural phenomena are supposed to exist beyond the *restrictions* of natural law. A ball falls at a rate of 9.8 meters per second per second – it has no choice in the matter and so is predictable and testable – but God, as Applegate (2013, p. 43) notes, is not so constrained and therefore His existence does not predict any specific set of observations.

This argument is unconvincing for two reasons. First, even if science can only evaluate claims that make empirical predictions, at least some supernatural hypotheses fit the bill. To that end, Sober (2011, p. 369) makes the excellent point that while ‘purely’ supernatural statements are probably untestable (e.g., ‘God loves me’, ‘Angels sing praises before God’s throne’, etc.), ‘mixed’ statements – those about the supernatural and its interaction with the physical world – are testable. Consider Fig. 1.

Each of these claims, because of their specific, empirical consequences, are at least scientifically falsifiable, a point Schick (2000, p. 33) makes as well.

Second, science can support supernatural claims even when those claims do not make predictions per se. Consider four examples...of evidence the corresponding

	<i>Hypothesis</i>	<i>Prediction</i>
A.	God created the world ten thousand years ago.	The world is 10,000 years old.
B.	The Bible is the inerrant word of God.	The Bible contains no factual errors.
C.	I am a modern-day prophet of Allah who has been tasked with warning humanity of the impending doom about to unfold upon us all.	My prophecies are accurate in all their detail.

**Fig. 1** Supernatural hypotheses and their corresponding empirical predictions

<i>The Evidence</i>	<i>The Hypothesis</i>
Every time after praying for healing, Christian amputees' limbs grow back.	The Christian God exists.
Muslims claiming to speak for Allah issue extensive prophecies that end up being true in all their detail decades later.	Allah has revealed himself to various prophets.
The stars rearrange themselves into the phrase, "I exist! Sincerely, God."	Theism is true.
A hundred thousand people simultaneously come back to life across the globe after being verifiably brain-dead for over six hours, all of them reporting remarkably similar experiences about what they can only describe as Heaven itself, complete with detailed, correct descriptions of the environment surrounding their body that they would not have been able to obtain while alive.	There is an afterlife.

**Fig. 2** Empirical evidence and the corresponding supernatural hypothesis that it supports

supernatural hypothesis that would receive substantial support from that evidence as outlined in Fig. 2:

In each case, the evidence, if observed, would clearly raise the probability of the corresponding supernatural thesis even though the latter does not predict the former in any obvious way: the Bible offers no guarantee of miracles, perhaps Muslim prophets would not unveil the future but instead stick to preaching the Qur'an, and so on. The overarching point is that even if some supernatural propositions are compatible with any set of observations and are therefore unfalsifiable, they may still be verifiable.

One might object that a Bayesian approach to theory confirmation entails that a set of data can only support a hypothesis if the latter predicts the former, at least to a greater extent than rival explanations.<sup>8</sup> I grant the point, but the Bayesian sense of 'prediction' is much weaker than what scientists typically mean by the term. For a theory to make predictions in the scientific sense, it has to have *expected* observational consequences. Theism, by contrast, doesn't lead us to expect the stars to rearrange themselves, even if the latter would be more probable on theism than atheism. In that case, an inference to theism satisfies the Bayesian desiderata without making predictions in the scientifically relevant sense.

<sup>8</sup> Thank you to Joseph Schmid for raising this concern.

### 3.2.2 Explaining Everything

In a similar vein to Pennock, Mahner (2012) contends that supernatural hypotheses fail as inferences to the best explanation because they are *omni-explanatory*: one could always account for some phenomenon by saying, ‘God did it’ (p. 1451). Any hypothesis that explains everything in fact explains nothing.

This charge fares no better than Pennock’s. First, while this undesirable feature may afflict some supernatural hypotheses, it does not afflict all of them (Boudry & Fishman, 2013, p. 941). (A), (B), and (C) are specific in what they attribute to the divine and therefore could not explain certain sets of observations: evidence for a 4.5-billion-year-old Earth, factual inaccuracies in the Bible, and false prophecies, respectively.

Second, even for those supernatural appeals that are always possible explanations for any phenomenon (e.g., ‘God brought this about’), it does not follow that they would always be the best explanation, as if one allowable appeal would destroy our ability to explain anything else via more mundane means. If one has a natural explanation for lightning bolts, for example, invoking the powers of Zeus would be superfluous and unjustified. The general point is that if “a plausible [natural] account emerges then it will constitute reason to reject an explanation in terms of supernatural agency” (Larmer, 2019, p. 13). So, even with omni-explanatory hypotheses, appeal to them is not an all or nothing affair.

In response to these kinds of considerations, Mahner (2012) objects on two grounds: first, postulating a supernatural entity in one case is a slippery slope to admitting “as many as we fancy,” and second, calling upon the supernatural immediately sets one on an infinite regress of explanations (p. 1451).

Neither objection succeeds. Against the first point, we can draw a parallel between supernatural invocations and claiming insanity to avoid punishment in a court of law. Allowing justified appeals to insanity in certain cases does not set one up on a slippery slope to allowing this type of defense for anyone. If there is no evidence that one is insane, a defendant does themselves no favors pleading not guilty by reason of insanity. Similarly, even in a world where we accept a supernatural explanation in a specific instance, *other* claims of supernatural intervention would still require justification.

The second objection cuts both ways. Regardless of the type of entity one invokes to make sense of the world, one can always continue seeking explanations for one’s explanations. The supernatural is not special in that regard.

### 3.2.3 Appealing to the Unknown

In addition to being omni-explanatory, Mahner (2012, p. 1451) contends that supernatural theories are *pseudo-explanatory*: appeals to the supernatural could never advance our knowledge of the natural world because our understanding of the supernatural is far less than any natural phenomenon we might call upon it to explain. To do so would be to explain the known in terms of the unknown.

I agree with Boudry and Fishman (2013, p. 942), however, that there are possible circumstances that obviously warrant inferring the supernatural even without a grasp

on its inner workings. For example, imagine Bob, a poor chap who underwent leg amputation as a child. Upon praying to a Higher Power one night for healing, his legs regrow in front of his eyes. In such circumstances, it would be reasonable for him to infer that some sort of divine being had answered his prayers, even without the slightest clue what that being may be like. Further inquiries can be left as open questions. The general point is that while one should certainly limit explanatory appeals to known entities and processes *all things being equal*, sometimes all things are not equal. Indeed, it is unclear how Mahner thinks scientific knowledge ever got started in the first place if not through invocation of novel mechanisms and processes.

### 3.2.4 Conclusion

In short, UNRESTRICTED fails because its second contention is under supported: there is no way to conclude *a priori* that all supernatural hypotheses are defective or poor, and therefore no way to know from the armchair that MN is the exclusive arbiter of truth about the natural world.

### 3.3 The Truth Seeking Objection

On the other side of the scale, there is a powerful argument against UNRESTRICTED: if science is exclusively concerned with uncovering the natural mechanisms at work in the world, what happens if in fact there are non-natural factors influencing nature? Science, restricted by its methodological commitments, would in that case prevent us from learning the truth (Boudry & Fishman, 2013, p. 923; Larmer, 2019, pp. 6–7; Ratzsch, 2004, p. 443). If, for example, God did miraculously create the first life on Earth, then origin of life researchers, constrained by MN, would never be able to find that fact out (Draper, 2005, p. 291). If science seeks truth, rather than ‘truth-as-seen-through-naturalist-glasses,’ it cannot start out by assuming a natural framework. With Kojonen (2017, p. 336), I call this the truth seeking objection.

## 4 Provisional Methodological Naturalism

One option at this point would be to abandon the claim that science is intrinsically committed to a methodology that excludes the supernatural. Accordingly, an increasing number of philosophers construe MN as a provisional principle rather than one built into the very fabric of scientific inquiry (Boudry et al., 2010; Boudry & Fishman, 2013; Dawes, 2011; Draper, 2005; Fishman, 2007; McDonald & Tro, 2009; Schick, 2000; Sober, 2011). On this view, supernatural explanations, while in principle possible for a scientist to propose, nevertheless have such a failed history at being good explanations that in practice the working scientist can ignore them. While INTRINSIC takes MN as a necessary assumption of scientific reasoning, PROVISIONAL sees MN as the *outcome* of scientific investigation down through history, a useful heuristic akin to, ‘prefer simpler theories, all things being equal.’ As it is only a guideline, the truth seeking objection does not apply to PROVISIONAL.

## 4.1 The Inductive Case

What arguments support the contention that MN is a fruitful, tested guideline for scientific research? McDonald and Tro (2009) argue for a straight-forward contention: “hypotheses that include supernatural or nonphysical elements as explicit explanatory entities generally have not been successful...in the history of modern science” (p. 202). First, Isaac Newton appealed to God to plug up a gap in his theory of gravitation: explaining why the planets orbit the Sun in the same direction and plane of motion. Unfortunately for Newton, Marquis de Laplace eventually proposed the nebular hypothesis, thereby providing a perfectly natural solution to this ‘planetary fine-tuning’ problem. Second, vitalism, the biological theory that an immaterial vital force distinguishes living from non-living things, eventually gave way to a physical understanding of organic life in the mid-nineteenth century. Third, scientists seriously considered, and eventually rejected, the attempt to integrate the flood narrative of Genesis with geological evidence in the nineteenth and early twentieth centuries. We can add to their list the most obvious and oft-cited example of the natural replacing the supernatural in science: Darwin’s theory of evolution replacing appeals to a designer (Dawes, 2011, p. 15; Bishop, 2013, p. 16). From these four detailed cases, we can reason inductively to the general empirical inadequacy of supernatural hypotheses.

In short, PROVISIONAL appears to be on solid ground. There will, of course, be differences of opinion about the relative strength of these examples. While it is true that modern organicist theories – theories that deny that the behavior of the whole organism is reducible to the behavior of its parts – resemble their older, vitalist predecessors, a recent defense of an organicist theory of the cell makes clear that modern formulations construe “emergent and irreducible activities and properties of organic wholes (cells and organisms) to be *perfectly natural* no less than the emergent properties of many inorganic wholes” (Denton et al., 2013, p. 33). Even if it departs from reductive physicalism, organicism is still consistent with a more expansive form of naturalism. When it comes to evolutionary theory and the history of life on Earth, some argue for the viability of creationist or intelligent design theories, views I do not agree with but will not attempt to assess here.<sup>9</sup> I will instead pursue two more general objections.

## 4.2 Objection 1: The Inductive Inference Is Weak

Kojonen (2016) makes the general point that “we have much less inductive support for believing that the natural sciences will eventually solve cases that are strongly disanalogous to those they have previously solved” (p. 300). Dilley (2010) then argues that “the origin of the universe, fine tuning, life, and the mind” (p. 134) are in fact strongly disanalogous to any prior area where MN has proven explanatorily successful. These two premises, taken together, weaken the grounds for adopting

<sup>9</sup> For a sophisticated statement of the view that scientific evidence calls evolutionary theory into question, see Meyer (2014). For a six-part response from scientists of various fields, see the articles available at <https://biologos.org/series/reviewing-darwins-doubt>.

MN in every area scientists currently work in. PROVISIONAL turns out not to offer much advice to a scientist when scientific investigation breaks into areas radically disanalogous to prior experience.

It is sober advice not to wantonly extrapolate from MN's past explanatory success to *every* domain of inquiry. In particular, the origin of the universe and of consciousness strike me as quite distinct from planetary motion, the nature of organisms, the origin of geological features, or the development of biological species, so the inductive case for MN in the former two cases will be more tenuous than with respect to, say, paleontology. Now, on the one hand, a scientist does not need to attribute to MN the same level of provisional strength in every area of investigation. On the other hand, however, one may desire a more plausible solution to the issue of MN's explanatory limits than potentially fragmenting scientific work between MN and non-MN domains of study. I will return to this issue when considering RESTRICTED.

### 4.3 Objection 2: Natural Theology Undercuts the Inductive Case

The second objection is that it is not clear that one can consistently affirm PROVISIONAL as well as certain arguments in natural theology (Kojonen, 2017, p. 338). Consider the much-discussed fine-tuning argument (FTA): the version of the FTA offered by Collins (2009) attempts to show that cosmic fine-tuning – the fact that certain aspects of the laws of physics have to fall within a narrow range of values if the universe is to allow for the evolution of biological life – is strong evidence for theism over naturalism. The argument is significant because it depends crucially on empirical evidence, and if it is successful, one cannot agree with Boudry et al.'s (2012) claim on behalf of PROVISIONAL that “supernaturalism surely has become a waste of intellectual time and effort” (p. 1153).

One possibility is to distinguish between ‘God’ as (i) a theoretical entity postulated as part of a scientific theory, and (ii) a conclusion in a philosophical argument that contains scientifically verifiable premises. If this is a valid distinction, then someone persuaded by natural theology can still hold to PROVISIONAL so long as the evidential basis for the latter draws from failures in (i) rather than (ii). It seems to me that the FTA does in fact fall under (ii), given that it rests in part on non-empirical reasoning in a way that properly scientific explanations do not: it asserts that it is not improbable that God would create a finely tuned universe.<sup>10</sup> But science as such cannot establish this claim about divine psychology. It is plausibly a metaphysical proposition justified on the basis of intuition as opposed to experimentation or observation,<sup>11</sup> a point that dovetails well with the insight offered earlier that science concerns itself with theories that are empirically verifiable.

However, the problem is that the explanatory appeals outlined in Sect. 4.1 failed, not because they were bad science per se, but because they were bad explanations more generally. Their failure therefore does at least *prima facie* weigh against empirical natural theological arguments like the FTA whether we construe the former along the lines of (i) or (ii). In other words, empirical natural theological arguments and the

<sup>10</sup> Thank you to Max Baker-Hytch for bringing this point to my attention.

<sup>11</sup> McMullins (2011, p. 90) makes a similar point in this connection as well.



history of science and the supernatural do not sit well with one another *regardless* of how we understand MN in relation to scientific methodology, whether in a provisional *or* a restricted way as explored below. The sword cuts both ways. But in light of the objection above, the more distinct the fine-tuning of the universe is from prior cases of explanatory failure, the less that failure weighs against the design inference at the heart of the FTA, so the natural theologian need not be too troubled.

#### 4.4 Preliminary Assessment

As is clear, our analysis has started to pull in inconsistent directions. First, is it unclear how to interpret the failure of supernatural explanations down through sciences history. Do we reject these explanations because they are *non-science* or merely *failed science*? While we have seen reason to think that supernatural appeals, and especially theistic ones, are not open to scientific evaluation (conclusions that reflection on the FTA only reinforces), we have here surveyed historical cases of the natural replacing the supernatural in scientific theorizing, suggesting that supernatural appeals constitute bad or failed science rather than something completely unevaluatable by scientific means. Second, it is unclear whether the inductive evidence justifies as *sweeping* a methodological commitment as we might want. How weighty is the failure of Newtonian appeals to God, for instance, when a scientist ventures into domains as recalcitrant as the foundations of consciousness or the origin of the universe? I contend that RESTRICTED resolves both of these tensions, so it is to that view that I now turn.

### 5 Restricted Methodological Naturalism

We may naturally conclude that there is something right about both provisional and intrinsic versions of MN. But insofar as we contend that MN is an essential feature of science, we will have to respond to the truth seeking objection.

#### 5.1 The Truth Seeking Objection, Reexamined

Kojonen (2017) argues plausibly that the truth seeking objection doesn't apply to INTRINSIC as such, but only to INTRINSIC *plus* the claim that science is the exclusive arbiter of truth within the natural domain – this latter view labeled scientism or “epistemic reductionism” (Kim, 2022, p. 167). UNRESTRICTED is precisely this combination. But what if we break apart these two claims, rejecting the thesis that MN is the only means we have for gathering information about nature? In that case, we can see MN – and by extension, science itself – as only applicable to those *aspects* of nature that are explicable under the framework of natural laws, processes, tractable theories, and so on. Science does not attempt to understand or systematize all truth, even all natural truth, but only those facts that yield to its methods of study.

If science is only one among several branches of rational inquiry, then one can argue for the view outlined in Kojonen (2017): restricted methodological naturalism. This thesis claims that (i) science is inherently committed to MN (the intrinsic element), but (ii) one can only find out which domains of inquiry science is applicable

to by going out into the world and seeing where naturalistic methodology works (the provisional element).

The idea behind (ii) is that evidence for the past success of natural explanations serves to show, not what proper scientific methodology *is* as PROVISIONAL asserts, but where that methodology *applies*. Should one find that natural explanations fail in a specific arena, one would not remove MN from science; instead, it would follow that science as such cannot investigate that arena. Kojonen (2017, p. 349) therefore bites the bullet and affirms that in the possible world where God creates the first life directly, for example, science as such would not be equipped to investigate the origin of life. But once one has rejected scientism, that conclusion would not issue in agnosticism about life's origin, for there are other disciplines, most notably philosophy, that would be equipped to analyze events outside science's reach. As such, RESTRICTED allows us not only to address the truth-seeking objection, but also to embrace the insights driving both intrinsic and provisional versions of MN.

## 5.2 Analysis

The argument for RESTRICTED is largely one of elimination: UNRESTRICTED falls prey to (1) the truth seeking objection, and PROVISIONAL, while promising, sits uncomfortably with (2) the modest case we have uncovered for seeing MN as intrinsic to scientific investigation, and (3) the problem of *unifying* scientific methodology when the inductive evidence may not justify so sweeping a generalization.

To account for all three considerations, the best approach is to say that while MN is essential to science, it is only through historical, inductive arguments that one can discern where scientific methodology is applicable in the first place. RESTRICTED allows us to appreciate the difference between two questions that are often jumbled together: (i) what methodologies are best suited for studying the natural world?, and (ii) what is the nature of scientific methodology? Kojonen's insight is that answering one does not automatically answer the other. Even if we have concluded that science is intrinsically limited to natural explanatory appeals, one can only determine the *range* of scientific investigation on the basis of *a posteriori* considerations like those advanced by MacDonald, Tro, Dawes, Draper, Boudry, and others. To the extent that one finds those considerations convincing, the range of a methodologically natural science will encompass the entire natural world. If, by contrast, one thinks that those historical arguments at best only show that *some* aspects of nature are best suited to analysis via natural science (Dilley, 2010), one can still embrace MN in science and study those other aspects through more philosophical means. In this way, RESTRICTED is a big tent that allows for several distinct approaches. Either way, scientific methodology itself remains unified.

## 5.3 Objections and Replies

### 5.3.1 Unsuccessful

Larmer (2022, p. 104) and Torrance (2018, p. 1097) both object that the truth seeking objection may still have force even if we conceive of science as restricted in the way

argued for here. Imagine evolutionary biologists investigating the origin of life in our hypothetical world where God created the first life by miraculous fiat. Kojonen seems to think that these biologists could recognize a gap in their naturalistic theorizing, and then appeal to a broader philosophical methodology to draw the correct inference that divine agency brought about life (or at least, to leave it an open question for the philosophers to debate). But how do we know our biologists would reason so humbly? It seems just as likely, if not more so, that they would find the best natural explanation of life's origin, commit to it, and thereby fall into error.

I think the concern here is exaggerated. Perry and Ritchie (2018), writing in a slightly different context, remind us that “a scientist will not...invent a naturalistic explanation in order to preserve an overarching metaphysical naturalist worldview. A good scientist understands that ‘I don’t know’ or ‘I don’t know yet’ is always a valid answer” (pp. 1075–6). Nothing forces our hypothetical biologists to simply adopt the best of a bad lot of natural hypotheses for the origin of life. They are allowed to plead ignorance, all the while seeking to uncover a plausible natural answer. With respect to IBE generally, Lipton (2004) makes the point that “[t]he best explanation must be good enough to merit inference: [IBE] must allow for agnosticism” (p. 63). We therefore need not grant Larmer’s (2019) claim that RESTRICTED entails that “all [natural] phenomena...*must* be given natural explanations, even if such explanations have little to recommend them as accurate” (p. 104; emphasis mine). There is no reason to think that science is compelled to bulldoze through anomalies and manufacture implausible hypotheses simply for the sake of explanation. At most, scientists will hold up ‘complete scientific explanation of nature’ as the goal, but nothing requires them to pull baseless theories out of thin air in the attempt to achieve that goal. To do so would be a hollow victory indeed.

### 5.3.2 Unrealistic

Larmer (2022) argues that “it will be very difficult to safeguard the disciplinary boundaries by which Kojonen wants to make [MN] provincial in its application” (p. 105). He makes the point that some scientists, in their attempts to argue for theistic evolution (the idea that God directs biological evolution rather than specially creating individual species), have often undermined the broader philosophical project of natural theology. They contend that empirical evidence could *never* support a supernatural inference, even in an explicitly philosophical setting. These scientists seem to have stepped outside their proper role as RESTRICTED envisions it.

What might one say in reply? First, a scientist can make philosophical claims without implying that we ought to equate philosophy with science. Scientists are free to engage in discourse about God’s interventionist strategies or lack thereof whenever they please, just as they are free to debate the literary merits of *The Grapes of Wrath* or the extent to which the Treaty of Versailles fostered the conditions that gave rise to World War II. The crucial point is simply that when they enter these debates, they are not speaking as scientists, but as philosophers, literary analysts, and historians, respectively. Of course, if those same scientists claim that their ‘non-interventionist’ views on God or their abysmal opinion of John Steinbeck’s prose are scientific inferences or required by scientific methodology, they are mistaken. All that follows, how-

ever, is that such scientists ought to be more careful in distinguishing their personal philosophical and literary views from what science itself mandates.

Second, given the failure to solve the problem of demarcating science from non-science (Laudan, 1983), there will always be cases that fall at the vague boundary between the two. Our extended discussion of INTRINSIC, however, gives us good reason to think that many supernatural theories *do not fall* at that boundary, much as debate between internalists and externalists in epistemology is clearly not a scientific issue, the failure of the demarcation problem notwithstanding. For those questions to which both science and philosophy have some legitimate claim, answering them is best seen as an interdisciplinary venture, and nothing about RESTRICTED precludes such a venture.

### 5.3.3 Uninformative

Finally, one might object to the idea of RESTRICTED as a ‘big tent’: perhaps the proposal is not all that informative after all, compatible as it is with any range one might want to attribute to science’s explanatory powers. That implication is correct – but RESTRICTED’s selling point is not in settling every controversial question raised by the interface of science and religion, but in correctly capturing the relationship between science, MN, the supernatural, and broader philosophical methods of inquiry, allowing us to frame contemporary debates – about fine-tuning or the origin of life or the beginning of the universe – in a way that does justice to the integrity of science, philosophy, and theology. It entails that efforts to paint supernatural hypotheses as intrinsically defective – e.g., Mahner (2012) or Pennock (2001) – are fruitless and unnecessary, because such hypotheses could theoretically prove explanatory without thereby being scientific. By the same token, efforts like those of Fishman (2007) to show how empirical evidence could undergird an inference to the supernatural do not show that MN is not intrinsic to science because not every justifiable inference from empirical evidence is automatically scientific. A theory can be *non-scientific* without being *pseudoscientific* or otherwise unreasonable (Monton, 2013). Finally, the careful historical documentation of supernatural hypotheses’ past explanatory failure as typified in McDonald and Tro (2009) is best construed, not as a reason for a scientist to adopt a certain methodology, but as a reason to have confidence that scientific methodology is the right one for studying the natural world.

## 6 Conclusion

In short, both tenets of RESTRICTED emerge as quite plausible, a conclusion that fits in well with similar and complementary ones reached by other studies of MN that emphasize science’s role as one tool among others in our explanatory arsenal (Kim, 2022; Halvorson, 2016; McMullin, 2001, 2011; Perry & Ritchie, 2018). So, could a scientist claim that some event happened because God made it so? As a scientist *qua* scientist, they could not – but as a scientist *qua* philosopher or, more simply, *qua* rational inquirer, yes, they could. To my mind, such a framework offers a promising

route forward in debates that are so often mired by conceptual confusion and rhetorical flourish, and I hope to have contributed something helpful to the conversation.

**Acknowledgements** I would like to thank Daniel Wolne, Eric Jackson, Erkki Kojonen, John Oetzel, Joseph Schmid, Mark Wynn, Max Baker-Hytch, Robin Collins, and Zachery Moffatt for offering feedback on various portions of the paper.

**Funding** The author did not receive support from any organization for the submitted work and the author has no relevant financial or non-financial interests to disclose.

**Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

## References

- Applegate, K. (2013). A defense of methodological naturalism. *Perspectives on Science and Christian Faith*, 56(1), 37–45.
- Bishop, R. C. (2013). God and methodological naturalism in the scientific revolution and beyond. *Perspectives on Science and the Christian Faith*, 65(1), 10–23.
- Boucher, S. C. (2020). Methodological naturalism in the sciences. *International Journal for Philosophy of Religion*, 88(1), 57–80.
- Boudry, M., & Fishman, Y. I. (2013). Does science presuppose naturalism (or anything at all)? *Science & Education*, 22(5), 921–949.
- Boudry, M., Blancke, S., & Braeckman, J. (2010). How not to attack intelligent design creationism: Philosophical misconceptions about methodological naturalism. *Foundations of Science*, 15, 227–244.
- Boudry, M., Blancke, S., & Braeckman, J. (2012). Grist to the mill of anti-evolutionism: The failed strategy of ruling the supernatural out of science by philosophical fiat. *Science & Education*, 21(8), 1151–1165.
- Clarke, S. (2009). Naturalism, science and the supernatural. *Sophia*, 48(2), 127–142.
- Collins, R. (2009). The teleological argument: An exploration of the fine-tuning of the universe. In W. L. Craig, & J. P. Moreland (Eds.), *The Blackwell Companion to natural theology* (pp. 202–281). Blackwell Publishing Ltd.
- Collins, R. (2016). Methodological theism. *Revista Brasileira De Filosofia Da Religião*, 3(2), 9–26.
- Dawes, G. W. (2011). In defense of naturalism. *International Journal for Philosophy of Religion*, 70(1), 3–25.
- Denton, M. J., Kumaramanichavel, G., & Legge, M. (2013). Cells as irreducible wholes: The failure of mechanism and the possibility of an organicist revival. *Biology and Philosophy*, 28, 31–52.
- Dilley, S. C. (2010). Philosophical naturalism and methodological naturalism: Strange bedfellows? *Philosophia Christi*, 12(1), 118–141.
- Draper, P. (2005). God, science, and naturalism. In W. J. Wainwright (Ed.), *The Oxford Handbook of Philosophy of Religion* (pp. 272–303). Oxford University Press.
- Fales, E. (2013). Is a science of the supernatural possible? In M. Pigliucci, & M. Boudry (Eds.), *Philosophy of pseudoscience: Reconsidering the demarcation problem*. University of Chicago Press.
- Feser, E. (2021). Natural and supernatural. In W. M. R. Simpson, R. C. Koons, & J. Orr (Eds.), *Neoplatonist metaphysics and the theology of Nature*. Routledge. (343–63).

- Fishman, Y. I. (2007). Can science test supernatural worldviews? In M. R. Matthews (Ed.), *Science, worldviews and Education* (pp. 165–189). Springer. [https://doi.org/10.1007/978-90-481-2779-5\\_9](https://doi.org/10.1007/978-90-481-2779-5_9).
- Forrest, B. (2000). Methodological naturalism and philosophical naturalism: Clarifying the connection. *Philo*, 3(2), 7–29.
- Gregory, B. S. (2008). No room for God? History, science, metaphysics, and the study of religion. *History and Theory*, 47(4), 495–519.
- Halvorson, H. (2016). Why methodological naturalism? In K. J. Clark (Ed.), *The Blackwell Companion to Naturalism* (pp. 134–149). Blackwell Publishing Ltd.
- Henderson, L. (2014). Bayesianism and inference to the best explanation. *British Journal for the Philosophy of Science*, 65(4), 687–715.
- Kim, J. (2022). A qualification of methodological naturalism: Brightman and De Vries revisited. *Theology and Science*, 20(2), 166–178.
- Kitzmiller v. Dover Area School District*, 400 F. Supp. 2d 707 (M.D. Pa. 2005).
- Kojonen, E. V. R. (2016). The God of the gaps, natural theology, and intelligent design. *Journal of Analytic Theology*, 4, 291–316.
- Kojonen, E. V. R. (2017). Methodological naturalism and the truth seeking objection. *International Journal for Philosophy of Religion*, 81(3), 335–355.
- Larmer, R. (2019). The many inadequate justifications of methodological naturalism. *Organon F*, 26(1), 5–24.
- Larmer, R. (2022). The prohibitive costs of methodological naturalism. *Philosophia Christi*, 24(1), 101–118.
- Laudan, L. (1983). The demise of the demarcation problem. In R. S. Cohen, & L. Laudan (Eds.), *Physics, Philosophy and Psychoanalysis* (pp. 111–117). Springer, Dordrecht.
- Lipton, P. (2004). *Inference to the best explanation* (2nd ed.). Routledge, Taylor and Francis Group.
- Mahner, M. (2012). The role of metaphysical naturalism in science. *Science & Education*, 21(10), 1437–1459.
- Mayes, G. R. (n.d.). Theories of explanation. *Internet Encyclopedia of Philosophy*, ISSN 2161–0002. <https://iep.utm.edu/explanat>.
- McDonald, P., & Tro, N. J. (2009). In defense of methodological naturalism. *Christian Scholar's Review*, 38(2), 201–229.
- McMullin, E. (2001). Plantinga's defense of special creation. In R. T. Pennock (Ed.), *Intelligent Design Creationism and its critics: Philosophical, theological, and scientific perspectives* (pp. 165–196). MIT Press.
- McMullin, E. (2011). Varieties of methodological naturalism. In B. L. Gordon & W. A. Dembski (Eds.), *The Nature of Nature: Examining the Role of Naturalism in Science* (82–94). Wilmington, Delaware: ISI Books.
- Meyer, S. C. (2014). *Darwin's Doubt: The Explosive Origin of Animal Life and the Case for Intelligent Design*. Bravo Ltd.
- Monton, B. (2013). Pseudoscience. In M. Curd, & S. Psillos (Eds.), *Routledge Companion to Philosophy of Science* (2nd ed., pp. 468–479). Routledge.
- Narveson, J. (2003). God by design? In N. A. Manson (Ed.), *God and Design: The teleological argument* (pp. 88–105). Routledge, Taylor & Francis Group.
- Okasha, S. (2016). *Philosophy of Science: A very short introduction*. Oxford University Press.
- Oppy, G., (Forthcoming ). Naturalism. A. H. Khani, & G. Kemp (Eds.), *Naturalism and its challenges*. Routledge.
- Papineau, D. (2021). Naturalism. *The Stanford Encyclopedia of Philosophy* <https://plato.stanford.edu/archives/sum2021/entries/naturalism>.
- Pennock, R. T. (2001). Naturalism, evidence, and creationism: The case of Phillip Johnson. In R. T. Pennock (Ed.), *Intelligent Design Creationism and its critics: Philosophical, theological, and scientific perspectives* (pp. 77–97). MIT Press.
- Pennock, R. T. (2007). God of the gaps: The argument from ignorance and the limits of methodological naturalism. In A. J. Petto, L. R. Godfrey, & Norton (Eds.), *Scientists confront Intelligent Design and Creationism*. 309–38).
- Pennock, R. T. (2009). Can't philosophers tell the difference between science and religion? Demarcation revisited. In R. Pennock, & M. Ruse (Eds.), *But is it Science? The philosophical question in the Creation/Evolution controversy*. Prometheus Books. (536–77).
- Perry, J., & Ritchie, S. L. (2018). Magnets, magic, and other anomalies: In defense of methodological naturalism. *Zygon*, 53(4), 1064–1093.

- Poe, H. L., & Mytyk, C. R. (2007). From scientific method to methodological naturalism: The evolution of an idea. *Perspectives on Science and the Christian Faith*, 59(3), 213–218.
- Ratzsch, D. (2004). Natural theology, methodological naturalism, and ‘turtles all the way down.’ *Faith and Philosophy*, 21(4), 436–455.
- Ruse, M. (1982). *Darwinism defended*. Addison-Wesley.
- Ruse, M. (1994). Darwinism: Philosophical preference, scientific inference and good research strategy. In J. Buell, & V. Hearn (Eds.), *Darwinism: Science or Philosophy?* (21–8). Foundation for Thought and Ethics.
- Ruse, M. (2001). Methodological naturalism under attack. In R. T. Pennock (Ed.), *Intelligent Design Creationism and its critics: Philosophical, theological, and scientific perspectives* (363–85). MIT Press.
- Schick, T. (2000). Methodological naturalism vs. methodological realism. *Philo*, 3(2), 30–37.
- Scott, E. C. (1998). Two kinds of materialism. *Free Inquiry (Buffalo, N.Y.)*, 18(2), 20.
- Simpson, W. M. R. (2021). From quantum physics to classical metaphysics. In W. M. R. Simpson, R. C. Koons, & J. Orr (Eds.), *Neo-Aristotelian Metaphysics and the Theology of Nature* (21–65). Routledge.
- Smith, T. (2017). Methodological naturalism and its misconceptions. *International Journal for Philosophy of Religion*, 82(3), 321–336.
- Sober, E. (2011). Why methodological naturalism? In G. Auletta, M. Leclerc, & R. A. Martinez (Eds.), *Biological evolution: Facts and theories* (pp. 359–378). Gregorian and Biblical Press.
- Swinburne, R. (2004). *The existence of God* (2nd ed.). Oxford University Press.
- Torrance, A. B. (2017). Should a Christian adopt methodological naturalism? *Zygon*, 52(3), 691–725.
- Torrance, A. B. (2018). The possibility of a theology-engaged science: A response to Perry and Ritchie. *Zygon*, 53(4), 1094–1105.
- Waller, J. (2019). *Cosmological fine-tuning arguments: What (if anything) should we infer from the fine-tuning of our universe for life?* Routledge, Taylor & Francis Group.
- Woodward, J., & Ross, L. (2021). Scientific explanation. In E. Zalta (Ed.), *The Stanford Encyclopedia of Philosophy* (Summer 2021 ed.). <https://plato.stanford.edu/archives/sum2021/entries/scientific-explanation/>.

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.