The Incompatibility of Naturalism and Scientific Realism

Robert C. Koons

Department of Philosophy

University of Texas at Austin

koons@phil.utexas.edu

December 22, 1998

1 Introduction

Whenever philosophers bother to offer a defense for philosophical naturalism, they typically appeal to the authority of natural science. Science is supposed to provide us with a picture of the world so much more reliable and well-supported than that provided by any non-scientific source of information that we are entitled, perhaps even obliged, to withhold belief in anything that is not an intrinsic part of our our best scientific picture of the world. This scientism is taken to support philosophical naturalism, since, at present, our best scientific picture of the world is an essentially materialistic one, with no reference to causal agencies other than those that can be located within space and time.

This defense of naturalism presupposes a version of scientific realism: unless science provides us with objective truth about reality, it has no authority to dictate to us the form which our philosophical ontology and metaphysics must take. Science construed as a mere instrument for manipulating experience, or merely as an autonomous construction of our society, without reference to our reality, tells us nothing about what kinds of things really exist and act.

In this essay, I will argue, somewhat paradoxically, that scientific realism can provide no support to philosophical naturalism. In fact, the situation is precisely the reverse: naturalism and scientific realism are incompatible.

Specifically, I will argue that (in the presence of certain well-established facts about scientific practice) the following three theses are mutually inconsistent:

1. Scientific realism
2. Ontological naturalism (the world of space and time is causally closed)
3. There exists a correct naturalistic account of knowledge and intentionality (representational naturalism)

By scientific realism, I intend a thesis that includes both a semantic and an epistemological component. Roughly speaking, scientific realism is the conjunction of the following two claims:

1. Our scientific theories and models are theories and models of the real world.

2. Scientific methods tend, in the long run, to increase our stock of real knowledge.

Ontological naturalism is the thesis nothing can have any influence on events and conditions in space and time except other events and conditions in space and time. According to the ontological naturalist, there are no causal influences from things "outside" space: either there are no such things, or they have nothing to do with us and our world.

Representational naturalism is the proposition that human knowledge and intentionality are parts of nature, to be explained entirely in terms of scientifically understandable causal connections between brain states and the world. **Intentionality** is that feature of our thoughts and words that makes them *about* things, that gives them the capability of being true or false of the world.

I take philosophical naturalism to be the conjunction of the ontological and representational naturalism. The two theses are logically independent: it is possible to be an ontological naturalist without being a representational naturalist, and vice versa. For example, eliminativists like the Churchlands, Stich and (possibly) Dennett are ontological naturalists who avoid being representational naturalists by failing to accept the reality of knowledge and intentionality. Conversely, a Platonist might accept that knowledge and intentionality are to be understood entirely in terms of causal relations, including, perhaps, causal connections to the Forms, without being an ontological naturalism. I will argue that it is only the conjunction of the two naturalistic theses that is incompatible with scientific realism.

Many philosophers believe that Scientific Realism gives us good reason to believe both Ontological Naturalism and Representational Naturalism. I will argue, paradoxically, that Scientific Realism entails that either Ontological Naturalism or Representational (or both) are false. I will argue that Nature is comprehensible scientifically **only if** nature is **not** a causally closed system – only if nature is the shaped by supernatural forces (forces beyond the scope of physical space and time).

My argument requires two critical assumptions:

PS: A preference for simplicity (elegance, symmetries, invariances) is a pervasive feature of scientific practice.

ER: Reliability is an essential component of knowledge and intentionality, on any naturalistic account of these.

2 The Pervasiveness of Simplicity

Philosophers and historians of science have long recognized that quasi-aesthetic considerations, such as simplicity, symmetry, and elegance, have played a pervasive and indispensable role in theory choice. For instance, Copernicus's heliocentric model replaced the Ptolemaic system long before it had achieved a better fit with the date because of its far greater simplicity. Similarly, Newton's and Einstein's theories of gravitation won early acceptance due to their extraordinary degree of symmetry and elegance.

In his recent book, *Dreams of a Final Theory*, physicist Steven Weinberg included a chapter entitled "Beautiful Theories", in which he detailed the indispensable role of simplicity in the recent history of physics. According to Weinberg, physicists use aesthetic qualities both as a way of suggesting theories and, even more importantly, as a sine qua non of viable theories. Weinberg argues that this developing sense of the aesthetics of nature has proved to be a reliable indicator of theoretical truth.

> The physicist's sense of beauty is ... supposed to serve a purpose – it is supposed to help the physicist select ideas that help us explain nature.[1]

> ...we demand a simplicity and rigidity in our principles before we are willing to to take them seriously. [2]

For example, Weinberg points out that general relativity is attractive, not just for its symmetry, but for the fact that the symmetry between different frames of reference requires the existence of gravitation. The symmetry built into Einstein's theory is so powerful and exacting that concrete physical consequences, such as the inverse square law of gravity, follow inexorably. Similarly,

---

[1]Steven Weinberg, *Dreams of a Final Theory: The Scientist's Search for the Ultimate Laws of Nature* (New York: Vintage Books, 1993), p. 133.

[2]Weinberg, *Dreams of a Final Theory*, pp. 148-9.

Weinberg explains that the electroweak theory is grounded in an internal symmetry between the roles of electrons and neutrinos.

The simplicity that physicists discover in nature plays a critical heuristic role in the discovery of new laws. As Weinberg explains,

> Weirdly, although the beauty of physical theories is embodied in rigid, mathematical structures based on simple underlying principles, the structures that have this sort of beauty tend to survive even when the underlying principles are found to be wrong.... We are led to beautiful structures by physical principles, but the beauty sometimes survives when the principles themselves do not.[3]

For instance, Dirac's 1928 theory of the electron involved an elegant formalism. Dirac's theory led to the discovery of the positron, and the mathematics of Dirac's theory has survived as an essential part of quantum field theory, despite the fact that Dirac's approach to reconciling quantum mechanics and relativity was wrong.[4] Similarly, mathematicians' pursuit of elegant mathematical theories has regularly anticipated the needs of theoretical physicists. The theory of curved space was developed by Gauss and Riemann before it was needed by Einstein, and group theory antedated its use in the theory of internal symmetry principles in particle physics. [5]

[3]Weinberg, *Dreams of a Final Theory*, pp. 151-2.

[4]Weinberg, *Dreams of a Final Theory*, p. 151.

[5]Weinberg, *Dreams of a Final Theory*, p. 152.

Weinberg notes that the simplicity that plays this central role in theoretical physics is "not the mechanical sort that can be measured by counting equations or symbols".[6] The recognition of this form of beauty requires an act of quasi-aesthetic judgment. As Weinberg observes,

> There is no logical formula that establishes a sharp dividing line between a beautiful explanatory theory and a mere list of data, but we know the difference when we see it.[7]

In claiming that an aesthetic form of simplicity plays a pervasive and indispensable role in scientific theory choice, I am not claiming that the aesthetic sense involved is innate or apriori. I am inclined to agree with Weinberg in thinking that "the universe acts as a random, inefficient and in the long-run effective teaching machine..."[8] We have become attuned to the aesthetic deep structure of the universe by a long process of trial and error, a kind of natural selection of aesthetic judgments. As Weinberg puts it,

> Through countless false starts, we have gotten it beaten into us that nature is a certain way, and we have grown to look at that way that nature is as beautiful.... Evidently we have been changed by the universe acting as a teaching machine and imposing on us a sense of

[6] Weinberg, *Dreams of a Final Theory*, p. 134.

[7] Weinberg, *Dreams of a Final Theory*, pp. 148-9.

[8] Weinberg, *Dreams of a Final Theory*, p. 158.

> beauty with which our species was not born. Even mathematicians live in the real universe, and respond to its lessons.[9]

Nonetheless, even though we have no reason to think that the origin of our aesthetic attunement to the structure of the universe is mysteriously prior to experience, there remains the fact that experience has attuned us to *something*, and this something runs throughout the most fundamental laws of nature. Behind the blurrin' and buzzin' confusion of data, we have discovered a **consistent** aesthetic behind the various fundamental laws. As Weinberg concludes,

> It is when we study truly fundamental problems that we expect to find beautiful answers. We believe that, if we ask why the world is the way it is and then ask why that answer is the way it is, at the end of this chain of explanations we shall find a few simple principles of compelling beauty. We think this in part because our historical experience teaches us that as we look beneath the surface of things, we find more and more beauty. Plato and the neo-Platonists taught that the beauty we see in nature is a reflection of the beauty of the ultimate, the nous. For us, too, the beauty of present theories is an anticipation, a premonition, of the beauty of the final theory. And, in any case, we would not accept any theory as final unless it were beautiful.[10]

[9] Weinberg, *Dreams of a Final Theory*, pp. 158-9.

[10] Weinberg, *Dreams of a Final Theory*, p. 165.

This capacity for 'premonition' of the final theory is possible only because the fundamental principles of physics share a common bias toward a specific, learnable form of simplicity.

3 The Centrality of Reliability to Representational Naturalism

The representational naturalist holds that knowledge and intentionality are entirely natural phenomena, explicable in terms of causal relations between brain states and the represented conditions. In the case of knowledge, representational naturalism must make use of some form of reliability. The distinction between true belief and knowledge turns on epistemic norms of some kind. Unlike Platonists, representational naturalists cannot locate the basis of such norms in any transcendent realm. Consequently, the sort of *rightness* that qualifies a belief as knowledge must consist in some relation between the actual processes by which the belief is formed and the state of the represented conditions. Since knowledge is a form of success, this relation must involve a form of reliability, an objective tendency for beliefs formed in similar ways to represent the world accurately.

A representational naturalist might make use, as do Dretske, Papineau and Millikan, of teleological properties, so long as these are taken to consist in the a set of causal and historical relations. Knowledge could then be identified with true beliefs formed by processes whose proper functions are fulfilled in normal circumstances. However, this teleological account also connects knowledge with reliability, since the proper function of belief-forming processes is to form true beliefs, so the sort of process which fulfills this proper function must be a reliable one.

Thus, if representational naturalism is combined with epistemic realism about scientific theories, the conjunction of the two theses entails that our processes of scientific research and theory choice must reliably converge upon the truth.

A naturalistic account of intentionality must also employ some notion of reliability. The association between belief-states and their truth-conditions must, for the representational naturalist, be a matter of some sort of natural, causal relation between the two. This association must consist in some sort of regular correlation between the belief-state and its truth-condition under certain conditions (the 'normal' circumstances for the belief-state).

For example, according to Papineau, beliefs have teleological purposes, and these purposes fix their truth conditions, since "beliefs are true when they fulfill their purpose of co-varying with the relevant circumstances"[11] This co-variation of representation and represented condition is what gives the capacity for belief is biological value. "According to the natural-selection story it is the fact that a belief-type 'typically' obtains in certain circumstances that will explain

[11] David Papineau, *Philosophical Naturalism* (Oxford: Blackwell, 1993), p. 177.

our having it in our repertoire..."[12] This regular association of belief-type and truth-conditions, and the biological purposes which the association serves, provide exactly the kind of naturalistic explication of intentionality that the representational naturalist requires.

This regular association is a form of reliability. As Fodor observed:

> ... we shall still have this connection between the etiology of representations and their truth values: representations generated in teleologically normal circumstances must be **true**. [13]

This reliability is only a conditional reliability: reliability under teleological *normal* circumstances. This condition provides the basis for a distinction between knowledge and true belief: an act of knowledge that p is formed by processes that reliably track the fact that p in the actual circumstances, whereas a belief that p is is formed by processes that would reliably track p in normal circumstances.

It is possible for our reliability to be lost. Conditions can change in such a way that teleologically normal circumstances are no longer possible. In such cases, our beliefs about certain subjects may become totally unreliable.

> It is the **past** predominance of true belief over false that is required....
> [This] leaves it open that the statistical norm from now on might be

[12] David Papineau, "Representation and Explanation," *Philosophy of Science*51(1984):558.

[13] Jerry A. Fodor, "Semantics, Wisconsin Style," *Synthese* 59(1984):247.

> falsity rather than truth. One obvious way in which this might come about is through a change in the environment.[14]

In addition, there may be specifiable conditions that occur with some regularity in which our belief-forming processes are unreliable.

> ...this link is easily disrupted. Most obviously, there is the point that our natural inclinations to form beliefs will have been fostered by a limited range of environments, with the result that, if we move to new environments, those inclinations may tend systematically to give us false beliefs. To take a simple example, humans are notoriously inefficient of judging sizes underwater.[15]

Finally, the reliability involved may not involve a high degree of probability. The correlation of belief-type and represented condition does not have to be close to 1. As Millikan has observed, "it is conceivable that the devices that fix human beliefs fix true ones not on average, but just often enough" [16] For example, skittish animals may form the belief that a predator is near on the basis of very slight evidence. This belief will be true only rarely, but it must have a better-than-chance probability of truth under normal circumstances, if it is to have a representational function at all.

[14]David Papineau, "Representation and Explanation," p. 558.

[15]David Papineau, *Philosophical Naturalism* , p. 100.

[16]Ruth Garrett Millikan, "Biosemantics," *Journal of Philosophy* 86(1989): 289.

Thus, despite these qualifications, it remains the case that a circumscribed form of reliable association is essential to the naturalistic account of intentionality. The reliability is conditional, holding only under normal circumstances, and it may be minimal, involving a barely greater-than-chance correlation. Nonetheless, the representational naturalist is committed to the existence of a real, objective association of the belief-state with its corresponding condition.

4 Proof of the Incompatibility

I claim that the triad of scientific realism (SR), representational naturalism (RN), and ontological naturalism (ON) is inconsistent, given the theses of the pervasiveness of the simplicity criterion in our scientific practices (PS) and the essentiality of reliability as a component of naturalistic accounts of knowledge and intentionality. The argument for the inconsistency proceeds as follows.

1. SR, RN and ER entail that scientific methods are reliable sources of truth about the world.

As I have argued, a representational naturalist must attribute some form of reliability to our knowledge- and belief-forming practices. A scientific realist holds that scientific theories have objective truth-conditions, and that our scientific practices generate knowledge. Hence, the combination of scientific realism and representational naturalism entails the reliability of our scientific practices.

2. From PS, it follows that simplicity is a reliable indicator of the truth about

natural laws.

Since the criterion of simplicity as a sine qua non of viable theories is a pervasive feature of our scientific practices, thesis 1 entails that simplicity is a reliable indicator of the truth (at the very least, a better-than-chance indicator of the truth in normal circumstances).

3. Mere correlation between simplicity and the laws of nature is not good enough: reliability requires that there be some causal mechanism connecting simplicity and the actual laws of nature.

Reliability means that the association between simplicity and truth cannot be coincidental. A regular, objection association must be grounded in some form of causal connection. Something must be causally responsible for the bias toward simplicity exhibited by the theoretically illuminated structure of nature.

4. Since the laws of nature pervade space and time, any such causal mechanism must exist outside spacetime.

By definition, the laws and fundamental structure of nature pervade nature. Anything that causes these laws to be simple, anything that imposes a consistent aesthetic upon them, must be supernatural.

5. Consequently, ON is false.

The existence of a supernatural cause of the simplicity of the laws of nature is obviously inconsistent with ontological naturalism. Hence, one cannot consistently embrace naturalism and scientific realism.

5 Papineau and Millikan on Scientific Realism

David Papineau and Ruth Garrett Millikan are two thoroughgoing naturalists who have explicitly embraced scientific realism. If the preceding argument is correct, this inconsistency should show itself somehow in their analyses of science. This expectation is indeed fulfilled. For example, Papineau recognizes the importance of simplicity in guiding the choice of fundamental scientific theories. He also recognizes that his account of intentionality entails that a scientific realist must affirm the reliability of simplicity as a sign of the truth. Nonetheless, he fails to see the incompatibility of this conclusion with his ontological naturalism. Here is the relevant passage:

> ...it is plausible that at this level the inductive strategy used by physicists is to ignore any theories that lack a certain kind of *physical simplicity*. If this is right, then this inductive strategy, when applied to the question of the general constitution of the universe, will inevitably lead to the conclusion that the universe is composed of constituents which display the relevant kind of physical simplicity. And then, once we have reached this conclusion, we can use it to explain why this inductive strategy is reliable. For if the constituents of the world are indeed characterized by the relevant kind of physical simplicity, then a methodology which uses observations to decide between alternatives with this kind of simplicity will *for*

that reason be a reliable route to the truth.[17]

In other words, so long as we are convinced that the laws of nature *just happen to be* simple in the appropriate way, we are entitled to conclude that our simplicity-preferring methods were *reliable* guides to the truth. However, it seems clear that such a retrospective analysis would instead reveal that we succeeded by sheer, dumb luck.

By way of analogy, suppose that I falsely believed that a certain coin was two-headed. I therefore guess that all of the first six flips of the coin will turn out to be heads. In fact, the coin is a fair one, and, by coincidence, the five of the first six flips did land heads. Would we say in this case that my assumption was a reliable guide to the truth about these coin flips? Should we say that its reliability was $\frac{5}{6}$? To the contrary, we should say that my assumption led to very unreliable predictions, and the degree of success that I achieved was due to good luck, and nothing more.

Analogously, if it is a mere coincidence that the laws of nature share a certain form of aesthetic beauty, then our reliance upon aesthetic criteria in theory choice is not in any sense reliable, not even minimally reliable, not even reliable in ideal circumstances. When we use the fact that we have discovered a form of "physical simplicity" in law A as a reason for preferring theories of law B which have the same kind of simplicity, then our method is reliable only if there is some causal explanation of the repetition of this form of simplicity in

[17] David Papineau, *Philosophical Naturalism*, p. 166.

nature. And this repetition necessitates a supernatural cause.

Papineau recognizes that we do rely on such an assumption of the repetition of simplicity.

> The account depends on the existence of certain general features which characterize the true answers to questions of fundamental physical theory. Far from being knowable *a priori*, these features may well be counterintuitive to the scientifically untrained.[18]

Through scientific experience, we are "trained" to recognize the simplicity shared by the fundamental laws, and we use this knowledge to anticipate the form of unknown laws. This projection of experience from one law to the next is reliable only if there is some common cause of the observed simplicity.

Similarly, Millikan believes that nature has trained into us (by trial and error learning) certain "principles of generalization and discrimination"[19] the provide us with a solution to the problem of theoretical knowledge that was "elegant, supremely general, and powerful, indeed, I believe it was a solution that cut to the very bone of the ontological structure of the world."[20] However, Millikan seems unaware of just how deep this incision must go. A powerful and supremely general solution to the problem of theory choice must reach a ground of the common form of the laws of nature, and this ground must lie outside the

[18] David Papineau, *Philosophical Naturalism* , p. 166.

[19] Millikan, "Biosemantics," p. 292.

[20] Millikan, "Biosemantics," p. 294

bounds of nature.

Papineau and Millikan might try to salvage the reliability of a simplicity bias on the grounds that the laws of nature are, although uncaused, brute facts, *necessarily* what they are. If they share, coincidentally, a form of simplicity and do so non-contingently, then a scientific method biased toward the appropriate form of simplicity will be, under the circumstances, a reliable guide to the truth.

There are two compelling responses to this line of defense. First, there is no reason to suppose that the laws of nature are necessary. Cosmologists often explore the consequences of models of the universe in which the counterfactual laws hold.

Second, an unexplained coincidence, even if that coincidence is a brute-fact necessity, cannot ground the reliability of a method of inquiry. A method is reliable only when there is a causal mechanism that explains its reliability. By way of illustration, suppose that we grant the necessity of the past: given the present moment, all the actual events of the past are necessary. Next, suppose that a particular astrological method generates by chance the exact birthdate of the first President of the United States. Since that date is now necessary, there is no possibility of the astrological method's failing to give the correct answer. However, if there is no causal mechanism explaining the connection between the method's working and the particular facts involved in Washington's birth, then it would be Pickwickian to count the astrological method as *reliable* in investigating this particular event.

Analogously, if the various laws of nature just happen, as a matter of brute, inexplicable fact, to share a form of simplicity, then, even if this sharing is a matter of necessity, using simplicity as a guide in theory choice should not count as reliable.

6 The Forster-Sober Account of Simplicity

In a recent paper,[21] Malcolm Forster and Elliott Sober offer a justification of the scientific preference for simplicity that seems to be compatible with scientific realism and yet which does not acknowledge any sense in which simplicity is a reliable indicator of the truth. If the Forster-Sober account provides an adequate explanation of the role of simplicity without any such reliable connection between simplicity and truth, then it would provide a serious challenge to the argument of the previous section. As Forster and Sober put it,

> In the past, the curve fitting problem has posed a dilemma: Either accept a realist interpretation of science at the price of viewing simplicity as an irreducible and *a prioristic* sign of truth and thereby eschew empiricism, or embrace some form of anti-realism. Akaike's solution to the curve fitting problem dismantles the dilemma. It is

[21] Malcolm Forster and Elliott Sober, "How to Tell when Simpler, More Unified, or Less *Ad Hoc* Theories will Provide More Accurate Predictions," *British Journal for the Philosophy of Science* 45(1994):1-35.

now possible to be a realist and an empiricist at the same time. [22]

The issue for Forster and Sober is realism vs. empiricism, whereas for us it is realism vs. naturalism, but it would seem that analogous claims could be made on behalf of Akaike's solution. This solution is supposed to give the realist some reason for preferring simpler hypotheses that is independent of any supposed correlation between simplicity and truth.

The Akaike solution goes something like this. First,we must assume that all of our observations involve a certain amount of noise – that random observational error regularly occurs, and the the error values are normally distributed. We divide the possible hypotheses into a finite sequence of families, based on the degree of simplicity (measured by the number of parameters that are allowed to vary within the family). Instead of selecting the hypothesis that best fits the actual data, we instead look for a family of hypotheses with the best combination of goodness-of-fit and simplicity, and choose the best fitting hypothesis within that set.

The rationale for the Akaike criterion is the avoidance of *overfitting*. Since the actual data includes some unknown observational error, the curve that best fits the data is unlikely to be the true one. It will tend to fit the actual data better than the true curve, which is called the 'overfitting' of the hypothesis to the data. Balancing goodness-of-fit with simplicity is supposed to mitigate this overfitting error. Consequently, the realist is given some reason to employ

[22] Forster and Sober, "How to Tell", p. 28.

simplicity as a desideratum of theory choice without assuming any correlation between simplicity and truth.

Simpler. low-dimensional families are much smaller than the more complex, high-dimensional families. There are therefore two reasons why the more complex families are more likely to contain the hypothesis that best fits the data:

> (a) Larger families generally contain curves closer to the truth than smaller families. (b) *Overfitting:* The higher the number of adjustable parameters, the more prone the family is to fit to noise in the data.[23]

According to Forster and Sober, we want to favor a family of hypotheses if it contains a good fit to the date because of reason (a), but not if it contains one because of reason (b). What is needed is an estimate of the expected degree of overfitting associated with each family, given the actual data. Akaike demonstrated that, under certain special conditions, we can find an *unbiased estimator* of this special form of error. By subtracting the number of parameters that are allowed to vary within a family from a measure of the degree-of-fit of the best-fitting curve within that family (this measure is one of log-likelihood or, in special cases, the sum of squares), we can arrive at a **corrected** estimate of the degree of fit of the family to the truth, which Forster and Sober call the "expected predictive accuracy" of the family. [24] The Akaike criterion tells us to

[23] Forster and Sober, "How to Tell", p. 8.

[24] Forster and Sober, "How to Tell", p. 10.

choose the best-fitting hypothesis within the family with the greatest expected predictive accuracy. In this way, we have both a definite rule for trading-off goodness-of-fit for simplicity, and a plausible rationale for making the tradeoff.

There are several points to be made in response to this solution. First, it is not at all clear that the role of simplicity in the kind of curve-fitting practices Forster and Sober discuss is at all analogous to the role simplicity plays in our choice of fundamental physical theories. As Weinberg observed, the kind of *simplicity* that guides our choice of fundamental theories is not easily defined. It does not correspond directly to what Forster and Sober mean by the *simplicity* of a family of hypotheses, viz., the number of variable parameters in the corresponding equations.

Second, the technical results upon which Forster and Sober rely are quite limited in their scope of application, as I. A. Kieseppä has demonstrated.[25] The Aikake estimator of predictive accuracy is valid only when the space of hypotheses is carefully circumscribed. For example, it is valid when the space of hypotheses includes only polynomial equations, but invalid when it includes periodic functions, like the sine wave function.[26]

Third, the rationale for the Akaike criterion is incompatible with the reliabilist implications of combining scientific realism with representational naturalism. The sort of 'scientific realism' that Forster and Sober have in mind is much

[25] I. A. Kieseppä, "Akaike Information Criterion, Curve-fitting and the Philosophical Problem of Simplicity," *British Journal for the Philosophy of Science* 48(1997):21-48.

[26] Kieseppä, "Akaike Information Criterion," pp. 34-37

less specific, implying only a concern with the truth of our scientific theories. Forster and Sober make no effort to demonstrate that reliance on the Akaike criterion leads reliably to the truth. Instead, they provide only a rationale that might reasonably motivate a realist to prefer simpler theories.

Finally, it is far from clear that even this rationale provides a basis for preferring simplicity that is genuinely independent of the reliability of simplicity as a sign of the truth. As has been pointed out by Kieseppä [27], Scott De Vito [28], and Andre Kukla [29], the Akaike solution presupposes that a determinate conception of simplicity is a given. There is no objective, language- and representation-independent way of "counting the parameters" associated with a given curve. A linear curve is *naturally* thought of as having a single parameter, but this can easily be altered by redescribing the curve or altering the coordinate system. Sorting hypotheses into families by simplicity as we perceive it reflects a prior and unjustified preference for some hypotheses over others.

Forster and Sober might insist that the sorting of hypotheses into a hierarchy of families is entirely arbitrary or random. As they present the argument for the Akaike criterion, all that matters is that the hypotheses be sorted into a sequence of families in which the size of the families increases exponentially, and

[27] I. A. Kieseppä, Kieseppä, "Akaike Information Criterion," pp. 21-48.

[28] Scott De Vito, "A Gruesome Problem for the Curve-Fitting Solution," *British Journal for the Philosophy of Science* 48(1997): 391-6.

[29] André Kukla, "Forster and Sober and the Curve-Fitting Problem," *British Journal for the Philosophy of Science* 46(1995):248-52.

that this sorting **not** be done in an ad hoc fashion, in response to the actual data observed. Then, when we observe a relatively small family F with a hypothesis h showing a surprisingly good degree of fit to the data (surprising, that is, in light of the smallness of F), we are supposed to have good reason to believe that F has a high degree of predictive accuracy, and, therefore, that we have reason to prefer h over other hypotheses with better fit that happen to belong to much larger families. However, if it was entirely a matter of chance or caprice that h ended up in a small family, and its better-fitting competitors ended up in larger families, it is hard to see how h's good fortune provides us with any rational ground for preferring it.

To the contrary, the plausibility of the Akaike solution depends on our prior conviction that simpler hypotheses (as measured by mathematical conventions that have proved reliable at this very task) are disproportionately probable. What Forster and Sober give us is a principled way of weighing the two competing desiderata of simplicity and goodness of fit, but they do not provide us with a rationale for treating simplicity as a desideratum in the first place.

Consequently, Forster and Sober do not provide us with a way of escaping the conclusion that a reliabilist conception of scientific realism entails the reliability of simplicity as an indicator of the truth.

7 Pragmatic Accounts of the Simplicity Criterion

A popular strategy for explaining the role of simplicity in scientific theorizing has been to appeal to a variety of pragmatic considerations. For example, Reichenbach argued that we favor simpler hypotheses because they are easier to represent, to make deductions from, and to use in calculations.[30] More recently, Peter Turney has argued that simpler hypotheses are more likely (given the presence of random observational error) to be repeatedly confirmed.[31]

However, these pragmatic justifications again sidestep the central issue, that of **reliability**. If our reliance on simplicity is unreliable, resulting in a bias toward simplicity that is not reflected in the constitution of nature, then we cannot combine scientific realism with representational naturalism.

A pragmatic justification of our scientific practice, when combined with representational naturalism, yields the conclusion that scientific theories must be interpreted non-representationally, either as mere instruments for generating empirical predictions, or as conventional constructs valid only for a local culture. Pragmatism, by eschewing any commitment to the objective reliability of

[30] Hans Reichenbach, "The pragmatic justification of induction," in *Readings in Philosophical Analysis*, ed. H. Feigl and W. Sellars (New York: Appleton-Century-Crofts, 1949), pp. 305-327.

[31] Peter Turney, "The Curve Fitting Problem – A Solution," *British Journal for the Philosophy of Science* 41 (1990):509-30.

scientific methods, cannot be combined with a naturalistic version of scientific realism.

8 Conclusion

Philosophical naturalism, then, can draw no legitimate support from the deliverances of natural science, realistically construed, since scientific realism entails the falsity of naturalism. If scientific theories are construed non-realistically, it seems that the status of ontology cannot be affected by the successes of natural science, nor by the form that successful theories in the natural sciences happen to take. If scientific anti-realism is correct, then the "manifest image" of the scientific worldview must not be taken as authoritative. Instead, that image is merely a useful fiction, and metaphysics is left exactly as it was before the advent of science.

Of course, naturalism as a metaphysical programme existed before the development of modern science (Democritus, Epicurus, Lucretius) and presumably it would survive the downfall of scientific realism. However, modern naturalists owe the rest of us a rational basis for their preferences that is independent of science.

In fact, the situation for the naturalist is even worse than I have described it. To the extent that the success of natural science provides support for scientific realism (in both its semantic and epistemic versions), to that extent it provides grounds for rejecting philosophical naturalism. Thus, conventional wisdom has the relationship between natural science and naturalism exactly backwards. In fact, the more successes natural science accumulates, the less plausible philosophical naturalism becomes.

There is a third thesis that is often included (especially since Quine) in the definition of naturalism: the continuity between the methods of philosophy and those of natural science, which we might call "meta-philosophical naturalism". Scientific anti-realism, when combined with meta-philosophical naturalism, leads to the conclusion of philosophical anti-realism, since philosophical theories are, according to metaphilosophical naturalism, merely a species of scientific theories.

This means that full-orbed naturalism (ontological + representational + metaphilosophical) is a self-defeating position. Full-orbed naturalism is a philosophical theory, and yet it entails philosophical anti-realism, which means that such theories cannot be known, and do not even purport to represent the world. Full-orbed naturalism cannot be true, since if it were true, it would entail that no philosophical theory (itself included) could be true.