

# No Understanding without Explanation

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*Studies in History and Philosophy of Science* 44, 510–515 (2013)

## ABSTRACT

Scientific understanding, this paper argues, can be analyzed entirely in terms of a mental act of “grasping” and a notion of explanation. To understand why a phenomenon occurs is to grasp a correct explanation of the phenomenon. To understand a scientific theory is to be able to construct, or at least to grasp, a range of potential explanations in which that theory accounts for other phenomena. There is no route to scientific understanding, then, that does not go by way of scientific explanation.

Understanding without explanation? Impossible, or so I will argue—in the case of science, at least. More particularly, I will defend in this paper a version of the following thesis concerning the connection between scientific explanation and understanding, which I call the *simple view*:

An individual has scientific understanding of a phenomenon just in case they grasp a correct scientific explanation of that phenomenon.  
(cf. Strevens 2008, 3)

The simple view analyzes understanding, then, as a certain kind of (externally valid) mental state. The view does not reduce understanding to explanation—the psychology of grasping is important and far from trivial—and so it is not what de Regt (2009) calls an “objectivist” view of understanding.<sup>1</sup> But it

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1. The objectivist view, according to de Regt, *identifies* understanding with explanation (de Regt 2009, 587).

does have the implication promised in the title, that explanation is essentially involved in scientific understanding, and that the norms of correct scientific explanation logically precede and participate in determining the nature and norms of understanding.

Does the simple view need a defense? Something like it can be found in many different philosophical works on understanding (de Regt and Dieks 2005; Grimm 2006; Khalifa 2012), although some of these writers would like to complicate the recipe with additional ingredients (see section 4). Yet I do not think that the fundamental pieces of the view have been laid out in sufficient detail—besides which, if the title of this collection, “Understanding without Explanation” is any guide, the simple view is hardly out of danger.

Although I advocate the simple view, I will argue that it ought to be regarded as one part of a bigger picture. The bigger picture will build on the central idea of the simple view, that scientific understanding is a matter of having the right epistemic relation to an explanation or explanations—and so that in science, there is no understanding without explanation.

**1. Explanation** Grasping a correct *explanation*. What is an explanation, such that it can be grasped?

It can be assumed, I think without any loss of generality, that an explanation is a set of propositions with a certain structure. Such a characterization is well suited, of course, to capture Hempel’s deductive-nomological and inductive-statistical accounts of explanation (Hempel and Oppenheim 1948; Hempel 1965), along with other accounts according to which explanations have the form of arguments, whether the arguments are explanatory ends in themselves or whether they represent structural elements of reality, such as the instantiation of unifying patterns (Kitcher 1981) or causal processes (Strevens 2008).

But almost any view of explanation can be put in these terms. On Salmon’s (1970) statistical relevance view, for example, an explanation is a table of

statistical information, while on Woodward's (2003) manipulationist view, it may take the form of a causal graph. Both are perfectly representable, if not canonically, in sentential form.

To grasp an explanation, I therefore propose, is to grasp two kinds of things: first, that the states of affairs represented by the propositions in fact obtain, and second, that the propositions instantiate the prescribed structure—for example, that they form a deductive argument for the explanandum (for Hempel) or that they stand in the right kinds of statistical relationship to the explanandum and to each other (for Salmon).<sup>2</sup> A sophistication will be added in section 3's discussion of idealizing explanation.

**2. Grasping** *Grasping* a correct explanation. What is it to grasp that a certain state of affairs obtains, or that a set of propositions stand in a certain relation to one another?

To grasp that a state of affairs obtains is to understand that it obtains; thus, grasping is a kind of understanding. There is no circularity here, however, because the kind of understanding that is constituted by grasping is not the kind of understanding that is supposed to be characterized by the simple view. Let me explain.

The cat is on the mat—so I will suppose. There are two ways you might be said to understand the situation. First, you might understand *that* the cat is on the mat, meaning that you are fully aware, you are entirely conscious, of the cat, the mat, and a certain spatial relation between them. (More on the nature of this mental state shortly.)

If you understand that the cat is on the mat, you might also understand *why* the cat is on the mat: perhaps the cat likes the mat, or perhaps it was drugged and left there to recover. This “understanding why” is quite separate

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2. When the structure represents an empirical matter of fact, such as the fact that the states of affairs represented by the propositions stand in the right kind of causal relationship to the explanandum and to each other (Strevens 2008), then this second grasping is of the same kind as the first grasping, namely, a recognition that some empirical fact obtains.

from “understanding that”: you might be exquisitely, incandescently aware of the cat’s being on the mat without having the slightest clue how it got there.<sup>3</sup>

The simple view is an analysis of understanding why, a view that is couched in terms of grasping propositions, which is a matter of understanding that. I have no account of understanding that, but to void the charge of circularity, it is enough to observe that it is entirely distinct from understanding why.<sup>4</sup> Let me try to say a little more, however, about this understanding that, this grasping.

Is grasping that a state of affairs holds the same thing as knowing that it holds? There are various dimensions along which this question might be explored. You might, for example, ask whether to grasp that a state of affairs holds you must be justified in believing that it holds, and if so, whether this justification can be “Gettier-ized”. I will not attempt an investigation of such questions;<sup>5</sup> let me rather give one reason that grasping must be something over and above knowledge (thereby dissenting from the view of Khalifa (2012), who otherwise presents something much like the simple view).

Someone with relatively little understanding of chemistry can, I think, know that water is made up of H<sub>2</sub>O, or that mercury is a metal. But they do not thereby grasp that these states of affairs hold in the sense required for understanding the chemical properties of water or mercury. In the same way that understanding that the cat is on the mat requires an appreciation of the

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3. Best not to treat the word “why” in “understanding why” as an implicit restriction: some kinds of understanding why would be more idiomatically expressed as understanding *how* (Khalifa in press). For example, it is perhaps more natural to speak of understanding how the dinosaurs went extinct than understanding why they went extinct, though there is no interesting difference between the two: either way, what is required is a correct explanation of the extinction.

4. Compare Hempel’s (1965, §4.1) discussion of various senses of the term *explanation*. Kvanvig (2003) makes a broadly similar, though not identical, distinction between “objectual understanding” and “propositional understanding”. His “explanatory understanding”, a species of objectual understanding, is more or less my understanding why.

5. For a discussion of the growing literature on this topic from Grimm, Kvanvig, and others, see Morris (in press).

relevant relation between cat and mat, understanding most of the properties of H<sub>2</sub>O requires an appreciation of the relation between the hydrogen and oxygen atoms in an H<sub>2</sub>O molecule; someone for whom “H<sub>2</sub>O” is just a symbol for some kind of molecule, they know not what, can know facts about H<sub>2</sub>O in the same way that someone who cannot distinguish elms and beeches can know facts about elms, but their acquaintance with such facts is not close enough to constitute the right kind of grasping.

To see this, imagine for simplicity’s sake that Newtonian gravitational theory is correct and consider someone who knows the tenets of the theory (the laws of motion and the gravitational force law), and knows that, given certain background conditions, they entail Kepler’s laws. They therefore know the propositions that constitute a correct explanation of Kepler’s laws (according to various accounts of explanation, including for example Hempel’s DN account), and they know that the propositions stand in the correct relation (in this case, a deductive argument) to constitute such an explanation. But they may nevertheless fail to grasp the propositions in a way that is sufficient for understanding.

They might, for example, though they know that Newton’s second law of motion is true, grasp very little of its content, or even misunderstand it in some way. If so, they are not in a position to understand phenomena explained by the law. Or they might, though they know that the laws and background conditions entail Kepler’s laws—having been informed by a reliable source, let us say—fail to *see* how the entailment goes, to *grasp* how the entailment goes. Then too, it seems to me, they fail to understand Kepler’s laws.

These cases show that the sort of grasping needed for understanding requires a more intimate acquaintance with the structure of the explanation than sometimes accompanies mere knowledge. It is not enough to know that one or more parts of, or conditions for, a correct explanation hold; their holding must be directly mentally apprehended. *Understanding that* is the

name for this direct apprehension.<sup>6</sup>

What is grasping, or understanding that, or direct apprehension, then? It is the fundamental relation between mind and world, in virtue of which the mind has whatever familiarity it does with the way the world is. The question of the nature of this relation is perhaps the deepest in all philosophy; I will not try to make any progress on it in this paper. That means, of course, that this paper will not pretend to give a complete account of understanding why; its aim is rather to show how such an account should depend on independent accounts of grasping and of explanation (the latter of which we are much closer to having, I think, than the former).

Let me give answers to two short questions about grasping, however. First: is grasping factive? Must the cat be on the mat, if you are to grasp that the cat is on the mat? Factivity seems to be implied by the “grasping that” locution; nevertheless, a friend of the simple view might, I suppose, find this implication unwelcome. Let me therefore briefly develop a non-factive notion to parallel “grasping that”. Suppose that grasping has two components: a purely psychological (or “narrow”) component, and the obtaining of the grasped state of affairs. What is wanted is the purely psychological state, the state that would persist in your mind if an evil demon, at the moment of your grasping that the cat is on the mat, destroyed the cat while maintaining in your mind the appearance of an enmatted cat. Call this state grasping\*. Then the simple view might be reformulated as follows:

An individual has scientific understanding of a phenomenon just in case they grasp\* a correct scientific explanation of that phenomenon.

In my view, an explanation is correct only if its constitutive propositions are true, so this reformulation is a difference that makes no difference, but the notion of grasping\* will find a philosophical use in what follows.

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6. What I have said in these paragraphs is compatible, note, with the view that understanding that is a special kind of knowledge (Grimm 2006), hence that knowledge is necessary but not sufficient for understanding that.

Second, can what is grasped invariably be verbally articulated? My motivation for posing this question is an argument of Lipton (2009) that militates against the simple view of understanding. Lipton gives the following example of inarticulable understanding why: after playing with an orrery, I might understand why the planets sometimes exhibit apparent retrograde motion, but I may be unable to articulate this understanding. I have to show you the orrery; I cannot, otherwise, tell you what I learned from it. But something that cannot be made explicit, according to Lipton, cannot be an explanation (because it cannot be communicated, or “given”, even to yourself). Therefore the understander with the orrery does not grasp an explanation of apparent retrograde motion.

Against Lipton, I suggest that understanding that, or grasping, a proposition does not imply an ability to make the proposition explicit. I can grasp a correct explanation, then, that I am unable to articulate; this, I submit, correctly describes the orrery case. I might add that a particular individual’s inability to communicate the explanation they grasp does not imply that the object of their grasping is inherently incommunicable or ungiveable, but merely that they are presently the wrong person for the job.

**3. Correctness** Grasping a *correct* explanation. Is correctness too high a standard?

Young earth creationists believe that the Grand Canyon was formed over a very short period (about a year) by a great flood. Suppose for the sake of the argument that their model for the canyon’s formation is sufficiently scientific to count as an explanation (though not of course a correct one)—say, because it invokes law-governed causal processes. Assume further that the creationists fully grasp\* all elements of their story (where grasping\*, as explained in the previous section, is the non-factive analog of grasping). Do they understand the formation of the Grand Canyon? Surely not, and this because their explanation is incorrect. Thus, correctness of explanation is a

necessary condition for scientific understanding.

And yet . . . consider three reasons for thinking that a more nuanced attitude to explanatory correctness is required.

First, many explanatory models in science contain idealizations; interpreted literally, these models are false. Scientists gain understanding, nevertheless, by grasping idealized models. A reason to abandon the simple view's requirement of explanatory correctness (Elgin 2007)?

No; at most a reason to use the term *correct* rather than, say, *true*—as the simple view already does. Why? The apparent falsehood of some models does not stand in the way of explanation, but that of others—as the young earth creationist case shows—most certainly does. The former class of models are “correct” in a sense that the latter class are not. Their correctness cannot, of course, consist in their literal truth. But if idealizing explanation is governed by any standard at all, there is a translation manual that, for any idealized model and context of (re)production, picks out a set of propositions that state the facts about the world that must obtain if the model is to be explanatory, and in virtue of which the model is explanatory, if they do obtain. Call these putative facts the *explanatory content* of the model.

In the simplest kind of idealized model, “All *F*s are *G*” might translate to, thus have the explanatory content, “Almost all *F*s are *G*”. Or it might have the explanatory content “In conditions *C*, all *F*s are *G*”, where the conditions *C* are determined by the context of production—the intentions of the explainer, for example.

My own view of the nature of the translation manual is more complex (Strevens 2008, chap. 8). I hold that idealizations that appear to make some false assumption about the world—for example, the assumption that there are no long-range intermolecular forces (in the ideal gas model), that biological populations are infinite (in some evolutionary models), that humans have perfect instrumental rationality (in economic models)—in fact make true claims about difference-making.

When used to explain the approximate truth of Boyle's law, for example, the ideal gas model, when it sets long-range intermolecular forces to zero, is in fact saying, when properly interpreted, that long-range intermolecular forces make no difference to the law's approximately holding. Likewise, population models in evolutionary biology that on the surface assume infinite populations are in fact saying that the size of the population (and hence, among other things but above all, genetic drift) made no difference to the occurrence of the phenomenon they are explaining—often, the fixation of a trait. Explanations in economics that on the surface assume perfect rationality are in fact saying that the various ways in which humans are irrational make no difference to the phenomena that they are attempting to explain. These models do not, as you can see, make their claims about difference-making explicit. You need the translation manual to extract the explanatory content, as sketched above and discussed at much greater length in Strevens (2008).

An idealizing explanation is correct if the propositions expressing its explanatory content, as opposed to its literal content, are true. Economic models that assume perfect rationality, for example, are correct only if irrationality really does make no difference to the phenomenon that they seek to explain (which is in many cases far from obvious). To say that understanding requires “grasping a correct explanation”, then, is to say that it requires grasping that the propositions expressing a relevant model's explanatory content are true, or in other words, understanding that the states of affairs represented by those propositions obtain.

Second, some might say that understanding is a narrow psychological state, not dependent for its existence on the way things are outside the skull. Such a view might seek to tie understanding more closely than does the simple view to the “sense of understanding” that the young earth creationists indubitably feel. I think that there is no reason to fight against this narrow notion of understanding why; we can allow the existence of two notions of understanding why, a broad notion that requires the correctness of a grasped

explanation and a narrow notion that does not. Where to look for the narrow notion, then? The simple view, I suggest—but substituting “potential explanation” for “correct explanation”. A potential explanation, as the term is used in the explanation literature, is one that satisfies what you might call the internal condition for explanatory correctness.

What does that mean? When he presented the deductive-nomological account of event explanation, Hempel distinguished logical and empirical requirements for an explanation’s being correct. His logical requirement was that the explanation should constitute a law-involving deductive argument for the explanandum’s occurrence, and his empirical requirement was that the premises of the argument should be true. You might generalize as follows: every account of explanation imposes internal and external conditions for explanatory correctness. The external condition consists in some match between the explanatory model and the external world; in the terms developed earlier in this section, the external condition requires that the propositions expressing the model’s explanatory content hold true. The internal condition holds or fails to hold independently of the way things are in the outside world. On a causal account of explanation, for example, the internal condition might stipulate that an explanation represent a potential causal history for the explanandum; the external condition would then stipulate that this must be in addition the explanandum’s actual causal history.

To understand why a state of affairs is the case in the broad sense, according to the simple view, is to grasp a correct explanation of that state of affairs. To understand the same state of affairs in the narrow sense is, I propose, to grasp\* an internally correct explanation of that state of affairs. (Observe that although narrow understanding why does not essentially involve correct explanation, it does essentially involve internally correct explanation; my titular thesis is therefore preserved.) If the young earth creationists’ proposed explanation of the Grand Canyon’s formation is internally correct, then we may say that they understand the formation in the narrow sense.

So far I have put the broad and narrow senses of understanding why on a par. Let me now discriminate: I think that our everyday attributions of understanding are almost always broad. For example, I cannot think of any conversational context in which it is correct to say, without frantic hedging, that the young earth creationists understand the formation of the Grand Canyon, or that the phlogiston theorists understood combustion. (Perhaps you can say that the phlogiston theorists had a way of understanding combustion, but that it was an incorrect way, and so they did not achieve the understanding that they sought.)

Further, I do not think that having narrow understanding is that much closer than having broad understanding to the purely phenomenal “sense of understanding”. Even if the young earth creationists’ explanation were to violate the internal standards for explanatoriness, they might experience a sense of understanding, a psychological or brain state—the firing of U-fibers?—which presumably can in pathological cases become uncoupled from any explanatory norm (Trout 2007).

The third reason to think that the correctness of an explanation is (at least sometimes) too high a standard for understanding arises in some cases when it is a theory, rather than a phenomenon or state of affairs, that is the subject of the understanding claim: sometimes we talk about understanding false theories. High school graduates are expected to understand Newtonian physics; historians of chemistry are supposed to understand phlogiston theory; and many cosmologists feel that they understand the inflation model of the early universe in a sense that is independent of whether it ultimately turns out to be correct.

This represents, I suggest, a third sense of “understanding” that might be called *understanding with*; the object of this understanding is, as I have said, a theory rather than a phenomenon or state of affairs. Like understanding why, and unlike understanding that, understanding with involves mastering a scientific explanation: to understand a theory in this new sense is to be

able to use that theory to explain a range of phenomena.<sup>7</sup> I leave it open whether understanding with requires the ability to construct explanations from scratch, or merely to appreciate them wherever they are encountered.

Understanding with comes in degrees: the wider the range of phenomena you can explain (considered as a proportion of the total explicable range), the better you understand the explaining theory. When you can explain, or grasp the explanation of, every phenomenon that the theory is in principle capable of explaining, you understand the theory completely, in the “understanding with” sense.

Understanding with does not require that the explanations in question be correct, but it does require that they satisfy the standards for internal correctness (as characterized earlier in this section). To have “understanding with” of Newtonian physics is to be able to construct or grasp an array of Newtonian explanations that are good in the sense that they are internally correct—they would be correct if only Newtonian physics were true.

It is clear, I hope, that understanding why and understanding with in science represent distinct epistemic achievements, both of which involve scientific explanation and both of which may be characterized using the English word “understand”. It would be correct to say that historians of science understand the phlogiston theory well, but wrong to say that the phlogiston theorists understood combustion well. Both claims turn on the “correctness” in some sense of phlogiston theory’s explanation of combustion; however, the former requires only that the explanation satisfy the internal standards for correctness, while the latter requires that it satisfy also the external standards. Thus the former claim is true while the latter is false.

The notion of understanding with neutralizes an apparent counterexample to the simple view. According to the simple view, to understand something

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7. Compare de Regt’s (2009) distinction between understanding a theory and understanding a phenomenon, though I give a somewhat different account of understanding a theory than does de Regt.

in the “why” sense is to grasp a correct explanation of that thing. It follows that whatever has no explanation, cannot be understood. Counterexample: As far as we know, general relativity is a fundamental theory (put aside its difficult relationship with quantum mechanics). As such, it has no scientific explanation; we can use relativity to explain many things, but we cannot explain relativity itself using further laws of nature, or else those laws, not relativity, would be what is fundamental.<sup>8</sup> The simple view implies, then, that general relativity cannot be understood—a conclusion at odds with our attributions of understanding to competent physicists.

The response to the objection is, of course, to distinguish understanding with and understanding why. Physicists *understand with* relativity, and that is what we mean when we say that they understand general relativity. But they do not *understand why* the theory of relativity is true—why, for example, mass interacts with space-time in the way that the theory stipulates. No one understands that; perhaps no one ever will.

#### 4. Brief Objections and Replies

*Objection: Understanding is a precondition for, not a product of, correct explanation.*

Reply: True in many ways. “Understanding that” and “understanding with” are preconditions for every explanation. But understanding why a phenomenon obtains is not a precondition for constructing an explanation of that phenomenon; the two arrive as twins, like proof and knowledge in mathematics.

*Objection: “Understanding why” comes in degrees; correctly explaining is an all or nothing matter.*

Reply: First, distinctions can be made between correct explanations of the

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8. Here I assume that a law can be explained only in terms of more fundamental laws. This is a substantive premise, but I know no account of explanation that rejects it.

same phenomena, with some said to be better or deeper than others. Railton (1981) proposes, for example, that an explanation that traces an event's causal history back further in time is better for it. Strevens (2008, §4.35) proposes that, other things being equal, a causal model that is more abstract than another is deeper in a certain sense than the other. Neither writer denies that explanations that fail to trace events back to the very beginning of things, or that fail to have the maximum possible generality (provided that they have enough generality), can count as correct explanations.

Second, there are degrees of grasping itself: if you are not completely clear on how the correct explanation of a phenomenon goes, but you have a good grasp of most of the explanation's elements, then you understand it pretty well but not perfectly.

In sum, both ingredients of understanding why according to the simple view—correct explanation and understanding that—come in degrees. The simple view is therefore well placed to account for the graded nature of understanding why.

*Objection: Understanding is holistic (Schurz and Lambert 1994; Elgin 1999); grasping propositions is atomistic.*

Reply: Among the states of affairs that make up an explanation is, as noted in section 1, the structural relation that the other parts of the explanation must stand in with respect to one another and to the phenomenon to be explained. In Hempel's DN account and Kitcher's unification account, for example, the states of affairs (or more exactly their propositional expression) must constitute a deductive argument for the occurrence of the explanandum. In Strevens' and others' causal accounts, they must constitute a causal difference-making process. And so on. To understand why is to grasp among other things this state of interrelation, and thus to grasp a property of the whole explanation that goes beyond the parts. On the simple view, understanding why is indeed holistic (and understanding with still more so).

*Objection: Understanding is active; it involves not only the comprehension of a theory but the ability to put the theory to use (Grimm 2006; de Regt 2009). So understanding cannot be a matter of merely grasping propositions.*

Reply: Some understanding is arguably active, namely, understanding with, if it is interpreted as involving an ability to construct explanations. Insofar as understanding is a matter of “merely” grasping propositions, however, it is understanding why. Thus it is possible to have it both ways: a certain kind of understanding is matter of grasping propositions, and a certain kind of understanding is a matter of having a particular ability, but they are not the same kind.

Why not add an active component to understanding why? Why not insist, for example, that to understand a phenomenon, you must not only grasp a correct explanation of the phenomenon, but be capable of constructing that explanation from its parts (de Regt and Dieks 2005; de Regt 2009)? Such a requirement is far too strong to capture ordinary understanding talk, I think: we may understand tidal phenomena, say, without having the ability—for lack of physical imagination, mathematical creativity, or whatever—to put together an explanation of the tides from gravitational physics. To have such an ability is no doubt strong evidence for understanding, but it is not a precondition for understanding.

Perhaps something weaker could be added instead; say, that to understand a phenomenon is to have the ability to see how its occurrence fits a correct explanatory model? That ability is already required by the simple view: to grasp what I called in the previous reply an explanation’s state of interrelation is to see how the explanandum follows from the model.

*Objection: Lipton (2009) gives good reasons to think that understanding can come by grasping facts that are not explanatory.*

Reply: I consider two of Lipton’s examples here; suffice it to say that they do not exhaust the content of this subtle paper (another aspect of which I

attempted to unpick in section 2).

Case one. You can understand why gravitational acceleration is independent of mass, Lipton claims, by grasping Galileo's famous argument: supposing that an object's acceleration is proportional to its mass, tie a heavier and a lighter object together with a rope. On the one hand, the lighter object should act as a brake on the heavier object, so together the two should fall more slowly than the heavy object falls alone. On the other hand, the two objects make a single object that is heavier still, so the the two should fall more quickly than the heavy object alone. Appreciating this contradiction, Lipton claims, allows you to understand why acceleration is independent of mass without grasping the scientific explanation of the fact (which turns ultimately on the equivalence of gravitational and inertial mass, accounted for by general relativity).<sup>9</sup>

The Galilean argument indeed provides, I think, a sense of illumination. It does so by harnessing a certain physical intuition, that the presence of the rope is not the sort of thing that influences the dynamics of falling. The illumination depends, in other words, on the listener's pretheoretical grasp of physics. But it amounts to genuine understanding why, I suggest, only insofar as the psychologically operative pretheoretical physical principles constitute a part of the *correct* physical explanation of the independence of acceleration and mass; otherwise, the listener is like the young earth creationists of section 3, apprehending an explanation, perhaps, but not the right one. My contention, then, is as follows: either the physical intuitions invoked by the Galilean argument are genuinely explanatory or they are not. If they are then there is understanding why in virtue of a grasping, in this case implicit, of a correct explanation (or rather, a part of such an explanation); if they are not then there is no understanding why but only the impression thereof.<sup>10</sup>

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9. Ignore the fact that, considered as a deductive argument, the Galilean train of thought is clearly elliptical.

10. I leave unaddressed the question, also raised by Lipton's example, whether a scientific explanation can have the logical form of a *reductio*, an impossibility argument. That is a

Case two. In a match between two boxers, Malloy and Wilson, it is agreed that Malloy will take a fall in the tenth round, although he is the far superior boxer. As it happens, Wilson fells Malloy in the fifth round with a “lucky uppercut”. Lipton argues that someone who knows only that the fight is fixed in Wilson’s favor can understand why Wilson wins, even though the explanation of the win depends entirely on the fortuitous punch, a state of affairs independent of the match-fixing.

It seems to me quite tendentious, however, that there is genuine understanding in this case. Lipton’s spectator may think that they understand why Wilson won, but they do not, because they grasp the wrong explanation for the match’s result. (I should also add that a number of writers have argued that “backup causes” such as the match-fixing arrangement do feature in correct scientific explanations—see for example Railton (1981) on the importance of the robustness of causal processes in statistical mechanics, Jackson and Pettit (1992) and Woodward (2003)—although I do not myself think that this is quite correct.)

*Objection: What about the Verstehen tradition in the social sciences?*

Reply: The subject of this paper is a kind of understanding that is found across the sciences, in physics and biology as well as in anthropology and sociology. The question whether there is a special kind of understanding proper to the latter disciplines would require an intensive examination of the differences between the natural and human sciences, something that is well beyond the scope of this paper.

**5. Conclusion** There are three senses in which it can be said that you understand a state of affairs: you might understand that it obtains, you might understand why it obtains, and if it is a theory or a theory part, you might understand how to use it to explain other states of affairs. These are under-

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fascinating question that cannot possibly be adequately treated here.

standing that, understanding why, and understanding with.

This paper has, first, developed and defended the simple view of understanding why, on which to understand why a fact obtains is to grasp an internally and externally correct scientific explanation of the fact, and second, offered a complementary account of understanding with, on which to understand a theory is to have the ability to use the theory to construct, or at least to comprehend, internally correct scientific explanations of a range of phenomena.

Both accounts are limited to science—to scientific understanding and scientific explanation—but they might easily be extended: to understand a moral rule might be to grasp a correct moral explanation of the rule (perhaps a derivation of the rule from fundamental moral principles) or to have the ability to use the rule to explain moral facts (for example, why lying is usually wrong).

So, can there be understanding without explanation? One answer does not fit all variants of the question. There can be no *understanding why* without a correct explanation. There can be no *understanding with* without internally correct explanations. But there can be *understanding that* without any explanations at all—aptly enough, since such understanding is the foundation of all inquiry.

Is that all there is to say about scientific understanding? My ideas about understanding why and understanding with are simple because they are derivative notions. The hard philosophical work lies in making sense of understanding that and of scientific explanation itself.

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