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Understanding Phenomena

Christoph Kelp*

Abstract

The literature on the nature of understanding can be divided into two broad camps. Explanationists believe that it is knowledge of explanations that is key to understanding. In contrast, their manipulationist rivals maintain that understanding essentially involves an ability to manipulate certain representations. The aim of this paper is to provide a novel knowledge based account of understanding. More specifically, it proposes an account of maximal understanding of a given phenomenon in terms of fully comprehensive and maximally well-connected knowledge of it and of degrees of understanding in terms of approximations to such knowledge. It is completed by a contextualist semantics for outright attributions of understanding according to which an attribution of understanding is true of one just in case one knows enough about it to perform some contextually determined task. It is argued that this account has an edge over both its explanationist and manipulationist competitors.

1 Introduction

It is often said that scientific inquiry aims at understanding various phenomena in the world. For instance, inquiry into the physics of gases aims at understanding the physics of gases and inquiry into the evolution of species at understanding the evolution of species. It is somewhat surprising, then, that the question of what understanding actually involves has for the longest time not been at the forefront of research in the philosophy of science. Fortunately, however, this lack

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*Centre for Logic and Analytic Philosophy, KU Leuven, Kardinaal Mercierplein 2, BE–3000 Leuven, Email: christoph.kelp@hiw.kuleuven.be

has recently been started to be supplied as there has been a increase of interest in the nature of scientific understanding.

It is fair to say that two camps can be distinguished in the literature. First, there are what I will call 'explanationists', who claim that understanding in essence involves knowledge of correct explanations [Hempel 1965, Salmon 1984, Khalifa 2012, 2013]. To take a popular example, to understand why planes fly involves knowing a correct explanation of why planes fly, for instance, in terms of Bernoulli's principle. Second, there are the 'manipulationists' according to whom understanding involves a specific kind of ability on the part of the cognitive agent, roughly, an ability to perform (certain kinds of) manipulations of (certain kinds of) representations of the phenomena understood [de Regt & Dieks 2005, de Regt 2009a,b, Grimm 2006, 2014, Wilkenfeld 2013].

In what follows, I look at a recent argument by Peter Lipton and argue the upshot of this argument is that the above conceptions over-intellectualise understanding (§2). Colloquially speaking, that means that they are making understanding a much more highbrow affair than it actually is. I will then look at ways in which manipulationists and explanationists might respond to Lipton's argument and argue that they remain unsatisfactory (§§3,4). Finally, I will offer a new account of understanding that avoids the problems of its competitors (§5).

2 Lipton's Argument

In a paper aptly entitled 'Understanding Without Explanation' Lipton convincingly argues that it is possible to acquire understanding of some phenomenon without acquiring an explanation of it. Lipton first distinguishes between explanations on the one hand and the cognitive benefits of explanations on the other. He then identifies understanding a phenomenon with having the cognitive benefits of an explanation of it and distinguishes between four types of cognitive benefits an explanation may offer: knowledge of (i) causal information, (ii) necessity, (iii) possibility and (iv) unification [Lipton 2009: 43-4]. In order to show that one can have understanding without explanations, he argues that one can come to enjoy these benefits of explanation without at the same time coming to have an explanation of the relevant phenomenon. More specifically, he adduces four cases in each of which the agent comes by one of the above-mentioned types

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of benefits without at the same time acquiring an explanation of the phenomenon at issue.

For the purposes of this paper, I would like to focus on one of Lipton's cases which involves knowledge of necessity without explanation. Lipton considers an agent who comes to know that it is impossible for gravitational acceleration to be dependent on mass by appreciating Galileo's famous thought experiment in which a heavy and a light mass are tied together. Intuitively, the agent comes to understand why gravitational acceleration is independent from mass here. At the same time, the agent does not acquire to knowledge of an explanation of why this must be so. The reason Lipton gives for this is that an explanation would have to offer "direct answer" to the question why acceleration is independent of mass, which the thought experiment does not provide. More specifically, Lipton suggests that "to explain by showing necessity requires a kind of constructive argument that not all proofs or thought experiments supply."[1] It is not hard to see that it is precisely constructive arguments that will enable their possessors to give direct answers to the relevant questions that are required by explanation. Crucially, however, arguments by *reductio ad absurdum* do not qualify as constructive in the relevant sense. Since Galileo's thought experiment offers at best a *reductio ad absurdum* of the proposition that mass and acceleration are not independent, it does not serve to explain why they are independent.[2]

The upshot of Lipton's argument for explanationist accounts of understanding is obvious. Given that one can understand a phenomenon without having an explanation of it, explanationist accounts of understanding are too demanding. More specifically, it seems plausible that the problem explanationism faces here is one of overin-

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[1] Lipton [2009: 47]. I take it that Lipton's theses (i) that explanations must offer direct answers to the relevant why questions and (ii) that explanations by showing necessity require constructive arguments constitute constraints that any satisfactory account of explanation (by showing necessity) will have to satisfy. As a result, his argument will go through on any viable account of explanation.

[2] [Lipton 2009: 47-8]. Note, first, that Lipton argues that the situation is analogous in the case of mathematical proofs which also allows for a distinction between explanatory and non-explanatory proofs. Here, too, Lipton is attracted by the idea that proofs by *reductio* are not explanatory. Second, those who are not convinced by this particular case may recall that Lipton offers three other cases of understanding without explanation. To those who remain unmoved by all of them, I'd say that the onus is on them to show why. Finally, third, for the purposes of this paper, I can in principle allow that understanding requires knowledge of explanations. What does matter is that non-explanatory knowledge can *improve* one's understanding of a given phenomenon (why will become clear in §5.)

tellectualisation. The intellectual demands they place on understanding—knowledge of an explanation—are unrealistically high. Less sophisticated cognitive achievements can qualify as understanding.

What is perhaps less obvious is that Lipton's argument also affects certain manipulationist accounts. Thus take the perhaps most famous version of manipulationism, which was first stated by Henk de Regt and Dennis Dieks [2005] and was subsequently developed by de Regt [2009a, 2009b]. The core idea here is that a phenomenon, P, is understood scientifically if and only if there exists an intelligible scientific theory, T, of it, where T is intelligible for scientists if they can recognise qualitatively characteristic consequences of T without performing exact calculations [de Regt 2009a: 593-4].

Now consider again Lipton's case of Galileo's thought experiment. Does someone who appreciates the point of the thought experiment thereby come by a *theory* of the relation between gravitational acceleration and mass? The answer to this question is very plausibly no. At the very best, Galileo's thought experiment affords us a *constraint* on theories of this relation. In fact, it is plausible that a theory of the phenomenon would enable one to give just the kind of constructive argument that Lipton points out Galileo's thought experiment fails to offer. Given that this is so, not only can one acquire understanding without knowing an explanation. One can also acquire understanding without possessing a theory of the phenomenon understood. In consequence, de Regt and Dieks's account of understanding is bound to fall prey to the overintellectualisation objection also.[3]

3   Manipulationism

3.1   Wilkenfeld's Representation Manipulationism

We have now seen that the most prominent version of manipulationism falls prey to the very same overintellectualisation problem that its explanationist rivals also encountered. The difficulty for de Regt and Dieks is that one can acquire understanding of a phenomenon even when one does not have a theory of it. The theory requirement de Regt and Dieks place on understanding is too strong.

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[3] I take it that there is little mileage in the idea that Galileo's understanding of the independence of gravitational acceleration and mass is not scientific, if only because Lipton's example is taken from the history of science.

With this point in play, it is not hard to see what sort of move manipulationists would have to make in order to rescue the account: they need to drop the theory requirement on understanding. This is the line taken in a recent paper by Daniel Wilkenfeld who proposes to replace the theory requirement by the following 'mental representation' requirement:

> (A) In order to understand some object x, a thinker must possess a mental representation of x.
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> [Wilkenfeld 2013: 1003]

There is reason to think that this move is exactly what is needed in order to deal with the overintellectualisation worry. After all, while a theory is a kind of mental representation, not every mental representation is a theory. It is worth noting that, in line with this observation, Wilkenfeld offers a very minimal characterisation of the notion of mental representation according to which mental representations "are computational structures with content that are susceptible to mental transformations."[4]

Wilkenfeld goes on to incorporate (A), the mental representation requirement on understanding, into the following manipulationist account of understanding:

> URM (Understanding as Representation Manipulability): A statement, attributed in context C, that thinker T understands object o, is true if and only if T possesses a mental representation R of o that T could (in counterfactuals salient in C) modify in small ways to produce R', where R' is a representation of o and possession of R' enables efficacious (according to standards relevant in C) inferences pertaining to, or manipulations, of o.
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> [Wilkenfeld 2013: 1003-4]

There are two crucial aspects to URM. First and foremost, to understand a phenomenon (or in Wilkenfeld's terminology 'object') is to have a mental representation of it that one is able to modify in such a way as to enable one to manipulate or make relevant inferences

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[4] [Wilkenfeld 2013: 1003]. It has been argued that the very notion of mental representation is problematic [e.g. van Fraassen 2008]. Of course, it will be bad news for Wilkenfeld if there is a problem already with the central notion of his account. However, for present purposes, I will not take a stance on this issue and so will not pursue this line against Wilkenfeld.

about the phenomenon. What counts as an ability to modify a representation in the relevant way? In Wilkenfeld's application of URM to particular cases, it becomes clear that at the very least one must be able to correct small errors in one's representation or put it to use to new cases [Wilkenfeld 2013: §3.1].

Second, URM offers a contextualist semantics for attributions of understanding. As Wilkenfeld points out, attributions of understanding are plausibly context sensitive. To take an extreme case, one and the same agent may be attributed understanding of a phenomenon—the geography of Scotland, say—in a context of primary school teachers discussing pupil performance in a recent exam, but would have to be denied understanding in a context in which members of a search committee discuss whom to hire for a recently advertised professorship in geography [Wilkenfeld 2013: 1007].

To see that this account avoids the overintellectualisation worry that de Regt and Dieks encountered, let's return once more to Lipton's case of Galileo's thought experiment. Even if the person who understands the independence of gravitational acceleration and mass via this thought experiment need not thereby have a theory of the phenomenon, he nonetheless does have a mental representation of it, to wit, the two connected masses falling. Moreover, it is plausible that his understanding here involves the ability to produce small modifications of the representation—e.g. viewing them as one mass vs. viewing them as two masses—which in turn enable him to infer a contradiction from the hypothesis that gravitational acceleration and mass are dependent. Thus, it would seem that the retreat to the kind of representation manipulability account of understanding will give manipulationists exactly what they need to avoid the overintellectualisation charge.

3.2 . . . In Trouble

Even so, there remain problems for Wilkenfeld's account. To begin with, it would seem that the notion of representation that is core to URM is too inclusive. Suppose *T* invents a story about the evolution of the Indian elephant according to which its evolutionary ancestors were a species of marine pygmy elephants that used to live at the bottom of the Indian ocean. Suppose *T*'s story is very detailed and, thanks to the powers of her imagination, she is able to manipulate it in various ways and to correct small errors in it. (We may even suppose that *T*'s story happens to be entirely accurate. Incredible as

we may find it, the Indian elephant did in fact evolve from a species of marine pygmy elephant that inhabited the bottom of the Indian Ocean.) Now we have a situation in which our thinker, T, has a representation of the evolution of the Indian elephant, *viz.* the story she invented. Moreover, T is able to modify this representation in ways that enable her to perform an impressive range of the kinds of inferences and manipulations required by URM. At the same time, it would seem that T's story has done nothing to advance her understanding of the evolution of the Indian elephant.[5] These considerations suggest that the notion of a manipulable representation is too liberal to constitute an appropriate basis for an account of understanding.

A different worry concerns the core manipulationist idea—that understanding requires the ability to *manipulate* representations, or perhaps a species thereof—more directly. To bring it out, consider a cognitive agent, O, who is omniscient. O knows everything there is to know. Intuitively, O will also be omni-understanding in the sense that O understands every phenomenon there is to understand. It is conceivable that O, while omniscient, is entirely passive, an unmoving knower, as it were. In particular, he does not draw inferences, make predictions, or manipulate his representations in any other way. (Of course, he knows which propositions can be inferred from which other propositions, which propositions warrant certain predictions, etc. However, he never makes those inferences or predictions. Notice also that this would make sense anyway. After all, he already knows the results of these inferences, predictions, etc. So there would be no need for any of this.) In fact, we may assume that O is passive not as a matter of pure happenstance, but because he does not even

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[5] If this isn't immediately obvious, suppose T is also a biology professor and goes on to include her new theory in her lecture on the Indian elephant, if only as an alternative to the standard theory. If her story did advance her own understanding of the evolution of the Indian elephant, we may suppose that it will position students to advance their understanding of this phenomenon as well. Since it is plausible that a central aim of biology lectures is to position students to advance their understanding of various biological phenomena (cf. §1), her including her theory in the lecture contributes towards attaining a central aim of the lecture. As a result, we should have no qualms about her including her new theory in the lecture. However, this is not the case. On the contrary, we would find it entirely unacceptable for her to include her new theory in her lecture. Why? The plausible answer is that her theory does not contribute towards attaining any of the aims of a biology lecture because it simply does position anyone to improve their understanding of the evolution of the Indian elephant.

have the ability to draw inferences, make predictions, or manipulate his representations. Even so, it remains plausible that since that O is omniscient, he is also omni-understanding in the relevant sense. If this is correct, then understanding does, of course, not require the ability to manipulate (species of) representations.

4 Explanationism

The classical form of explanationism (CE) can avoid both of these problems of URM. To see this recall that, according to CE, understanding is knowledge of correct explanations. Unlike Wilkenfeld's URM, this view places much stricter requirements on the kind of representation that constitutes understanding: understanding is a species of *knowledge*. This allows CE to avoid the problem of the imaginer, T, who imagines a certain situation and perhaps explanations pertaining to it. After all, imagining an explanation is one thing, knowing it is another. Moreover, unlike manipulationism in general, CE encounters no difficulties with the case of the omniscient but passive agent, O. Since O is omniscient he knows all the correct explanations there are to know. Given that understanding is knowledge of correct explanations, by CE, O also understands every phenomenon there is to understand. CE can accommodate the intuition that omniscient cognisers, even when passive, are also omni-understanding without further difficulties.

That said, Lipton's cases of understanding without explanation continue to constitute a problem for the view. Perhaps, however, the problem can be solved. Perhaps there is a way of modifying the view that retains both the spirit and the benefits of CE whilst not falling prey to Lipton's counterexamples. In a recent 2013 paper Kareem Khalifa presents a view that promises to achieve just this. In the remainder of this section I will first sketch Khalifa's view and then outline some problems the view encounters.

4.1 Khalifa's Explanatory Idealism

Khalifa's core idea is that knowledge of correct explanations is not required for understanding. Rather explanations—or, to be more precise, correct and good explanations—constitute the *ideal* of understanding. According to this view, explanations set the standard for understanding in the sense that the degree of (non-explanatory) understanding is measured in terms of "how well it approximates

the cognitive benefits provided by knowing a correct and good explanation" [Khalifa 2013: 166].

Before moving on, let us briefly reflect on exactly what standard Khalifa has in mind here. Given that understanding comes in degrees and given that we attribute understanding outright[6], the following three options suggest themselves:

(1) Explanation sets the standard for *maximal* understanding. Enjoying the cognitive benefits of knowing a correct and good explanation is tantamount to having the highest degree of understanding.

(2) Explanation sets the standard for attributions of *outright* understanding. Enjoying the cognitive benefits of knowing a correct and good explanation marks the threshold for the degree of understanding that is needed for an outright attribution of understanding to come out true.

(3) Explanation sets the standard for *minimal* understanding. Enjoying the cognitive benefits of knowing a correct and good explanation is tantamount to having the lowest positive degree of understanding.

It is not hard to see that neither (2) nor (3) are plausible candidates for Khalifa here. After all, Lipton's examples show not only that one can have a non-zero degree of understanding of the relevant phenomena without knowing a correct and good explanation, but also that people can be attributed outright understanding of these phenomena without such knowledge. In Lipton's Galileo example, for instance, appreciation of the thought experiment affords one understanding of why gravitational acceleration is independent of mass. That is to say, the sentence 'One understands the independence of gravitational acceleration and mass' is true in the context of Lipton's discussion of the case. Given, additionally, that in this context an outright attribution of understanding is true only if one has a non-zero degree of understanding, it follows that one must also have a non-zero degree of understanding of the relevant phenomenon.

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[6] When I use the term 'outright' in 'outright attribution of understanding' and similar constructions, I mean 'not involving degrees'. For instance, assertions of statements of the form 'S understands P' are outright attributions of understanding. In contrast, assertions of statements of the form 'S understands P to degree d', 'S_1 understands P better than S_2' are not.

The kind of standard Khalifa must have in mind is thus (1), that explanation sets the standard for maximal understanding. Notice that this also fits nicely with his talk of correct and good explanations constituting the *ideal* of understanding. After all, it is independently plausible that understanding is ideal when possessed to the highest degree. In order to provide further support for his thesis, Khalifa goes on to argue that understanding of a phenomenon via knowing some explanation is always better than the understanding of the phenomenon without explanation.

4.2 . . . In Trouble

Unfortunately, there are a couple of problems with Khalifa's account. One arises from a consideration Khalifa himself considers at a different point in the paper: that knowledge of correct and good explanations might be insufficient for understanding. To return to the independence of gravitational acceleration and mass, consider a student who has read and has since memorised that gravitational acceleration depends on net forces acting on an object rather than on mass and that, as a result, gravitational acceleration is independent of mass. It is often argued that this student knows a correct and good explanation of the phenomenon at issue but cannot plausibly be said to understand the independence of gravitational acceleration from mass. Khalifa replies that understanding comes in degrees and that while the student has some positive degree of understanding, he could have better understanding of it in virtue of knowing further details, better explanations, etc. [Khalifa 2013: 166]

Now, while I find Khalifa's response plausible, it does not sit comfortably with the earlier idea that knowledge of a correct and good explanation constitutes the ideal and thus the highest degree of understanding. After all, the student in this case knows a correct and good explanation of the independence of gravitational acceleration and mass. By the earlier idea, then, the student has attained the highest degree of understanding, whilst, according to the present response, he hasn't.

It might be pointed out on behalf of Khalifa that there is no need to take the ideal of understanding to consist in knowledge of any old explanation that is good and correct. Instead, the demands on explanations could be raised. One plausible suggestion here is that attaining the highest degree of understanding a phenomenon requires knowledge of the best and most complete correct explanation of the

phenomenon. On this account, since the student knows a good and correct explanation of the phenomenon at hand, he continues to have some degree of understanding of it. At the same time, since he does not know the best and most complete correct explanation of it, he falls short of the ideal, which gives Khalifa exactly what he needs.

This move does not avoid the second problem, which arises from the fact that knowing some explanation of a phenomenon does not enable one to discount alternative explanations of the phenomenon. For instance, suppose that, at t_1, our student is told that gravitational acceleration depends on net forces acting on an object and has thereby come by a correct and good explanation of the phenomenon. A little later on, at t_2, she is presented with an alternative explanation of the very same phenomenon, the Aristotelian, say. Without any further knowledge, she will be unable to decide which of the two explanations to accept. That said, if our student subsequently, at t_3, learns about Galileo's thought experiment, she can dismiss the Aristotelian explanation of gravitational acceleration. It is highly plausible that, at t_3, she has a better understanding of gravitational acceleration than she did at t_1. Still her knowledge of a correct and good explanation of the phenomenon is the same at t_1 and t_3. At both t_1 and t_3, our student knows that gravitational acceleration depends on net forces acting on an object. The knowledge that she has come by in the meantime, that according to Aristotle, gravitational acceleration depends on mass and that this can independently be shown to be impossible, is not part of the explanation of the phenomenon. It comes to light, then, that non-explanatory knowledge can improve understanding that comes in the form of knowledge of explanations.

One might again say that the problem here is that the explanation our student knows may not be the best and is certainly not complete. Even if this is true of our toy case, the underlying point remains unaffected. To see this let, let e_1 and e_2 be complete explanations of a given phenomenon, P. Suppose e_1 not only complete but also correct and in fact the best explanation of P. At t_1, S is told and thereupon comes to know that e_1 explains P. Subsequently, at t_2, S is presented with the prima facie equally plausible alternative e_2. Without further information, S will be unable to dismiss e_2. After all, even the best explanations may not wear their seal of quality on their sleeves. However, when at t_3, S learns all about an impossibility result concerning e_2, she is finally in a position to dismiss one of the two explanations. Again, it is no less plausible here than in the above case that the

agent's understanding at t_3 is better than at t_1. However, again, the additional information is not part of the correct, complete and best explanation (e_1) of the phenomenon. As a result, the improvement of S's understanding at t_3 compared to t_1 is owed to the acquisition of additional *non-explanatory* knowledge. Thus even if we raise the standards for the ideal of understanding to knowledge of an explanation that is not only correct and good but even complete and best, knowledge of such an explanation is still compatible with improvement of understanding. If so, Khalifa is mistaken. Explanation does not constitute the ideal of understanding.

Before moving on, I would like to spend a few moments on a contrary argument by Khalifa that, in the case of Galileo's thought experiment, there will be some explanation such that knowing this explanation entails having the information provided by the thought experiment. Having pointed out that Galileo's thought experiment in essence shows that a certain kind of explanation of gravitational acceleration (in terms of mass) is incorrect, he states the core idea of his argument in the following passage:

> Let *critical information* be true beliefs that potential explanations are incorrect. Then knowing an explanation requires critical information. Specifically, true beliefs falling short of knowledge are generally thought to be lucky, and critical information helps to mitigate that luck. For instance, if someone has no way of ruling out some other underlying cause of a patient's symptoms, at best he has luckily guessed the cause of those symptoms, but he does not know. Similarly, if someone knows the correct explanation of acceleration (e.g. that acceleration is a result of the net forces acting on an object), then she should be able to rule out rival explanations, such as the mass hypothesis, or else she merely has guessed luckily. So if an explanation provides someone with explanatory knowledge, she also possesses critical information. Presumably, better explanations rule out more rival hypotheses, and thus convey a lot of critical information.
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> [Khalifa 2013: 173-4]

With the above considerations in play, it is not hard to see where Khalifa's argument goes astray. Contrary to what he claims, knowing an explanation does *not* require true beliefs that potential alternative

explanations are incorrect. This is especially clear when the relevant knowledge is acquired via testimony. When an agent acquires knowledge of a certain explanation via testimony from one source and later is offered an alternative (prima facie equally plausible) explanation by a different (equally trustworthy) source, the agent cannot dismiss the alternative explanation just on the basis of the fact that she believes the initial explanation to be true.[7]

5 An Alternative Account

It has become clear that there are serious difficulties with manipulationism and explanationism, both in their classical and more recent incarnations. That said, I do believe that there are important insights on both sides and the account I favour incorporates a number of them. First, however, I would like to give a brief characterisation of a central notion in my account, *viz.* the notion of phenomenon.

5.1 Phenomena

Metaphysically, phenomena form a rather heterogenous bunch: persons (Barack Obama), objects (Planet Earth), events (The Big Bang), processes (the rise of the Roman Empire), instantiations of properties and relations (the independence of mass and acceleration) all qualify. And, of course, this list remains incomplete.

Crucially, phenomena must be *actual* in a relevant sense. Obama and Planet Earth exist at the actual world. The Big Bang occurs at the actual world as does the rise of the Roman Empire. Mass and acceleration instantiate the independence relation at the actual world. This is why they may count as phenomena. In contrast, Obama's twin sister and the 28th planet of our solar system do not exist at the

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[7] Compare also Kripke's dogmatism paradox:

(1) Φ

(2) If Φ, then any future evidence against Φ is misleading.

(3) Hence, any future evidence against Φ is misleading.

It is now widely acknowledged among epistemologists that even if one knows Φ, one need not therefore also believe that any future evidence against Φ is misleading. After all, acquisition of new evidence concerning Φ changes one's epistemic position towards Φ, which might undermine one's knowledge of Φ, even if this evidence is in fact misleading. The same is true of explanations. Even if one now knows that e explains P, this does not require one to believe that any alternative explanation of P that future scientific research may produce is incorrect.

actual world. *Creatio ex nihilo* does not occur in actuality and neither does the rise of the Finnish Empire in the 20th century. Mass and acceleration do not instantiate the dependence relation in the actual world. That's why they do not count as phenomena.

Doesn't the metaphysical heterogeneity of phenomena render a uniform account of understanding problematic? Shouldn't we offer separate accounts for different kinds of phenomena? Fortunately, there is reason to think that this won't be necessary. After all, for every phenomenon, no matter its metaphysical nature, there is a set of true propositions that describes it (henceforth its "description"). For instance, in the case of Earth, its description includes true propositions about its size and shape, its composition, etc. In addition, there is a set of true proposition describing its place in a broader nexus of phenomena, which we may call its "story". In the case of Earth, its story includes true propositions concerning its position in our solar system, its movement around the sun, etc. Finally, let's call the union of a phenomenon's description and story, its "full account". If understanding of a given phenomenon is taken to be a relation between agents and phenomena, it is hard to see how a uniform account could be forthcoming. On the other hand, if understanding is cashed out as a relation between agents and full accounts of phenomena (or relevant subsets thereof), the prospect for a uniform account of understanding even of metaphysically heterogenous kinds of phenomena start to look much brighter again.[8],[9]

5.2 Degrees of Understanding

Early accounts of understanding have tended to focus mainly on outright understanding. That is to say, they have ventured to give an account of the state one is in when a statement of the form '*A* understands *P*' is true of one. In contrast, both Wilkenfeld and especially Khalifa are acutely aware that understanding comes in degrees and

[8] Note that the same goes for knowledge. It is widely agreed that knowledge is a relation between an agent and a proposition. As a result, there is no reason to think that a uniform account of knowledge about metaphysically diverse phenomena will be problematic.

[9] It is common practice in the epistemology literature to distinguish between two types of understanding, to wit, propositional understanding, which takes individual propositions as its objects and objectual understanding the objects of which are "bodies of information" [Kvanvig 2003: 191]. Given the above characterisation of phenomena, it is easy to see that the proposed account of understanding phenomena qualifies as an account of objectual understanding.

venture to give an account of what it takes for an agent to have a certain degree of understanding. I think this is an important improvement. As will be become clear in due course, I take degrees of understanding to be more fundamental than outright understanding in the sense that we first need an account of degrees of understanding in order to be able to give an account of outright understanding. The tendency in the literature to start with an account of outright understanding and build an account of degrees of understanding on top of it, which effectively amounts to the project of first identifying a minimal threshold for what it takes to understand a phenomenon and then account for higher degrees of understanding, is one of the fundamental errors in the literature. The fact that so many accounts face an overintellectualisation worry, that they set the bar for understanding too high, is just a symptom of this mistake.

In fact, I think that Khalifa is right to characterise degrees of understanding starting from an ideal rather than from a minimal threshold. His problem is that he identifies the wrong ideal. My alternative proposal is departs from the following intuitively highly plausible idea: knowing everything there is to know about a phenomenon is understanding it as well as it can be understood. In other words, the idea is that to have *fully comprehensive knowledge* of the full account of the phenomenon (henceforth simply "fully comprehensive knowledge of the phenomenon" for short) is to have maximal understanding of it.

While this idea goes a long way towards capturing the ideal of understanding, there is reason to think that it needs one further refinement. To see why, let's first consider the case of an agent, A, who knows the following set, Γ, of propositions about an event, E, in which the application of a sample of a substance causes a piece of litmus paper to change colours from blue to red: (p_1) the application of a sample, s, of a certain kind of substance to a certain piece of blue litmus paper caused the litmus paper to turn red; (p_2) applications of acidic substances, and only of acidic substances, to blue litmus paper cause blue litmus paper to turn red; (p_3) s is a sample of an acidic substance; and (p_4) application of s caused the piece of blue litmus paper to turn red because s is a sample of an acidic substance (p_1 because p_3).

What is the state of A's understanding of E? Ordinarily, we would expect the answer to this question to be "not bad". But now suppose that A knows each $p_i \in \Gamma$, via testimony from a different source. To

make things even clearer, suppose that, for each $p_i \in \Gamma$, A had been told p_i in a different language. At present A has not yet translated them all into one language. How would we assess A's understanding of E now? Probably quite a bit less positively. While A has some knowledge about E, A's knowledge is entirely unconnected and so A has little to no understanding of E.

Note that it is not clear that adding further knowledge, perhaps of propositions describing the connections between the members of Γ, will solve the problem. To see this, suppose that we allow A to have ever more knowledge about E until he has fully comprehensive knowledge of E. At the same time, suppose that A knows each member of the full account of E via testimony from different sources, where each source testifies in a different language. Let's assume, as we may, that A masters all of these languages. In that case, A has fully comprehensive knowledge of E. At the same time, A understands little more than he did when he first came to know the members of Γ, at least so long as A has not done the translation yet. He still only has a bunch of unconnected knowledge.[10]

Let us say that an agent's fully comprehensive knowledge about some phenomenon, P, is *maximally well-connected* when the basing relations that obtain between the agent's beliefs about P reflect the agent's knowledge about the explanatory and support relations that obtain between the members of the full account of P. For instance, in the above case, when A has fully comprehensive knowledge of E, he will know that p_1 and p_2 entail p_3 and that p_4 embodies a correct and good (causal) explanation of p_1 in terms of p_3. In order to have maximal understanding of E, our agent must not only know $p_1 - p_4$, but also believe p_3 based on the fact that p_1 and p_2 entail p_3 and p_4 based on the fact that p_3 constitutes a correct and good (causal) explanation of p_1. The reason why A has little to no understanding of E when he acquires each item of knowledge from a different source in a different language is that his knowledge about E is minimally well-connected: none of the support relations that he knows to obtain between members of the full account of E is reflected in the basing relations that obtain between his beliefs.

With these points in play, here is my account of maximal understanding

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[10] Note that the point about different languages does not play any substantive role in this argument. It is simply meant make perspicuous the possibility of having unconnected knowledge.

MAXIMAL UNDERSTANDING (MAX-U)

If one has fully comprehensive and maximally well-connected knowledge a phenomenon P, then one has maximal understanding of P.[11]

Notice that MAX-U will allow us to avoid two difficulties that we encountered earlier. First, it accommodates the idea that our omniscient agent, O, is an omni-understanding agent. Or, to be more precise, O will be omni-understanding provided that his knowledge is also maximally well-connected, a condition that, I assume, we took as read in the original description of the case.[12] O is an agent who

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[11] Since the account is stated in terms of knowledge, it presupposes that understanding is a form of knowledge (U=K). It may be worth noting that, for the purposes of this paper at least, this presupposition is inessential. To see this, notice, first, that the central aim of this paper is to argue that my account is preferable to its two most prominent competitors in the philosophy of science literature (explanationism and manipulationism) as it can steer clear of the problems they encounter. Notice, next, that this aim can be achieved even on variants of my account that do not presuppose U=K. Consider, for instance, the following two variants of MAX-U:

MAX-U′
If one has fully comprehensive and maximally well-connected justified beliefs about a phenomenon P, then one has maximal understanding of P. (The variants of DEG-U and OUT-U (see below) are as expected.)

MAX-U″
If one has fully comprehensive and maximally well-connected justified true beliefs about a phenomenon P, then one has maximal understanding of P. (The variants of DEG-U and OUT-U (see below) are as expected.)

Neither MAX-U″ nor MAX-U″ presupposes U=K. MAX-U′ construes understanding as a form of justified belief (U=JB), MAX-U″ as a form of justified true belief (U=JTB). At the same time, it is easy to see that both variants enjoy the benefits of my account vis-à-vis explanationism and manipulationism. The paper's central aim can thus be achieved just as well if my knowledge based account is abandoned in favour of either variant. For that reason the presupposition of U=K is inessential for the purposes of this paper. Finally, note that most epistemologists who reject U=K accept either some version of U=JB or of U=JTB. As a result, there is reason to believe that my presupposition of U=K is not epistemologically problematic.

[12] Note if O's knowledge is not maximally well-connected it is not clear that O will also be maximally understanding. If O's beliefs are minimally well-connected in the way A's beliefs were in the above case, it would seem that O, too, understands little to nothing at all. That said, it is actually not clear that O could be both omniscient and yet fail to have maximally well-connected knowledge. To see this, consider a proposition p that, let's suppose, O knows that p based on testimony from T. Since O is omniscient, O would also know that he knows that p based on testimony from T. Now suppose that T knows that p because T saw that p. Since O is omniscient, O would also have to know that T saw that p. However, it is not clear that O could know that p based *only* on testimony from T, when he also

has fully comprehensive and maximally well-connected knowledge of the full account of any phenomenon whatsoever. So, by Max-U, O has maximal understanding of all phenomena and does so whether or not, like O, he happens to be passive by nature.

Second, it avoids the problem that besets Khalifa's explanatory idealism. To see this recall the case of the student who, at t_1, is told and thereupon comes to know the best correct and complete explanation of a given phenomenon, P, subsequently, at t_2, learns of an alternative, prima facie equally plausible explanation of P and, at t_3 is finally able to dismiss the alternative thanks to a thought experiment like Galileo's that shows the alternative explanation to be impossible. Explanatory idealism cannot accommodate the plausible idea that our student's understanding improves between t_1 and t_3. After all, at t_1, our student already knows the best correct and complete explanation of P and has thus reached the ideal. In contrast, Max-U faces no particular problem here. After all, our student acquires new knowledge about the story of P between t_1 and t_3, including that there is an alternative explanation of P (t_2) and that the explanation, although prima facie no less plausible than the one he already had cannot be true after all (t_3). Hence, at t_1, he did not have fully comprehensive knowledge of the full account of P and so, at t_1, he had not reached the ideal.

With Max-U in place, I want to suggest that the quality of one's understanding of a phenomenon can then be measured in terms of approximations to maximal understanding—i.e. fully comprehensive and maximally well-connected knowledge—of it.

> DEGREES OF UNDERSTANDING (DEG-U)
> Degree of understanding of P is a function of distance from fully comprehensive and maximally well-connected knowledge of P: the closer one approximates fully comprehensive and maximally well-connected knowledge of P, the higher one's degree of understanding of P.[13]

knows that T saw that p. After all, O state would then be irrational in a way that is not evidently compatible with his omniscience.

[13] It is tempting to think that degrees of understanding depend on degrees of breadth and depth of understanding and that approximations to fully comprehensive knowledge measure breadth of understanding and approximations to maximally well-connected knowledge measure depth of understanding. That said, I will not pursue the project of offering a precise account of degrees of understanding in any more detail here. Fortunately, I don't have to, at least not for the purposes of this paper. Recall that the main aim here is to offer an account that compares

DEG-U offers an account of degrees of understanding without imposing a minimal threshold for understanding. It is thus ideally suited to avoid the overintellectualisation worries that so many accounts which aim to specify such a threshold encounter.[14]

DEG-U does serve to handle the case of the story-teller *T*, which posed a problem for Wilkenfeld's version of manipulationism. Recall that *T* uses her imagination to invent a story according to which the Indian elephant evolved from a species of marine pygmy elephants that used to inhabit the bottom of the Indian Ocean. Recall also that, intuitively, this did not advance *T*'s understanding of the evolution of the Indian elephant. DEG-U can explain why. After all, *T*'s use of her imagination in this case does not deliver new knowledge about the evolution of the Indian elephant. In consequence, *T* does not advance in the direction of fully comprehensive and maximally well-connected knowledge of this phenomenon. Given that this is so, DEG-U predicts that *T*'s use of her imagination in this case does not improve her understanding of the evolution of the Indian elephant. Thus, the present account steers clear of this problem, too.

5.3 Outright Understanding

Of course, the question remains how we are to account for outright understanding. Here manipulationists have a couple of core insights. First, I think that it is here that the core manipulationist idea—that understanding involves being able to do something—is of relevance. The second insight resides in Wilkenfeld's observation that outright attributions of understanding afford a contextualist semantics.

In order to account for outright understanding, I would like to first connect the second insight with MAX-U and DEG-U. MAX-U and DEG-U give us an account of maximal understanding in terms of fully comprehensive and maximally well-connected knowledge and

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favourably with its rivals on both the manipulationist and the explanationist side. Now notice first that, while everyone agrees that understanding comes in degrees and allows for evaluation in terms of depth and breadth, no one has offered anything that comes even close to a detailed account of degrees of understanding. For that reason, my account is not at a disadvantage vis-à-vis its explanationist and manipulationist rivals on this front. Second, as will become clear in due course, my account can avoid the problems that beset its rivals without recourse to a precise account of degrees of understanding. In consequence, I can arguably claim an advantage over both manipulationism and explanationism for my account.

[14] I don't mean to suggest that there might not be a minimal threshold for understanding. Again, even if there is one, for the purposes of this paper, it won't be necessary to specify it.

of degrees of understanding in terms of distances to fully compre-
hensive and maximally well-connected knowledge. My suggestion is
to incorporate the contextualist idea in terms of a contextually vari-
able threshold of distance from maximal understanding. If one is
close enough to fully comprehensive and maximally well-connected
knowledge of a given phenomenon to surpass the threshold in a
given context, then one can truly be attributed understanding of the
phenomenon in that context.

The manipulationist's first insight, that understanding involves
being able to do something, can then be used to account for how the
threshold is set. The idea here is that the threshold is set by a task
concerning the phenomenon such that one is close enough to fully
comprehensive knowledge of a given phenomenon just in case one
would successfully perform this task, if one were to have any the
relevant skills needed to do this. In other words,

> OUTRIGHT UNDERSTANDING (OUT-U)
> "*S* understands *P*" is true in context *c* if and only if *S* ap-
> proximates fully comprehensive and maximally well-connected
> knowledge of *P* closely enough to be such that *S* would (be
> sufficiently likely to) successfully perform any task concerning
> *P* determined by *c*, if, in addition, *S* were to have the skills
> needed to do so and to exercise them in suitably favourable
> conditions.[15]

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[15] It might be thought that the subjunctive conditional here is problematic. After
all, as Robert Shope [1978] has argued at length, biconditionals featuring a sub-
junctive are prone to what he calls "the conditional fallacy". In the simplest case,
the biconditional is of the form '$p \leftrightarrow (q \mathbin{\square\!\!\rightarrow} r)$'. In one version of the fallacy (V1),
p is true and q is not, but if q were true, q's being true (and/or r's being true)
would lead to p's no longer being true. In another version of the fallacy (V2), p
is true and q is not, but if q were to be true, this would lead to r's no longer be-
ing true. Fortunately, there is reason to think that OUT-U does not fall prey to the
conditional fallacy. Concerning V1, note that we can add further conditions to the
antecedent of the subjunctive such that they entail that the left-hand side of the bi-
conditional is true. A biconditional of the form '$p \leftrightarrow ((p \wedge q) \mathbin{\square\!\!\rightarrow} r)$' will evidently
be safe from V1. In the case of OUT-U, we can require that the context remains the
same and *S* approximates fully comprehensive knowledge to the same degree and
in the same way. Since whether or not an agent surpasses the threshold depends
only on the context and the degree and way of approximation to fully comprehen-
sive knowledge, adding the above conditions to the antecedent guarantees that if
the antecedent of the subjunctive is true, the left-hand side of OUT-U is true also.
Concerning V2, note that if the corresponding conditional is necessarily true, again
there is no need to worry: '$p \leftrightarrow ((p \wedge q) \mathbin{\square\!\!\rightarrow} r)$' will evidently be safe from V2 when
'$p \leftrightarrow \square((p \wedge q) \rightarrow r)$' is true also. In OUT-U, the addition of the proviso that con-
ditions be suitably favourable arguably ensures that the corresponding conditional

Notice that again there is excellent reason to think that Out-U will not fall prey to the overintellectualisation problem. After all, the contextually determined tasks may be very easy. In certain contexts, for instance, when talking about small children, knowing enough to be able to answer a set of fairly easy multiple choice questions may do the trick.

Notice that Out-U can accommodate the idea that outright attributions of understanding are true of our omniscient but passive cogniser, O, for all phenomena and in any context. After all, while O does not have the ability to perform any tasks whatsoever, this is not due to a lack of knowledge but due to a lack of additional skills that would be needed to carry out these tasks. For that reason, O does know enough about P to be such that O would (be sufficiently likely to) successfully perform any task concerning P whatsoever, if O were to have the skills needed to do so and to exercise them in suitably favourable conditions. Out-U thus predicts that outright attributions of understanding are true of O, for all phenomena and in any context.

For the same reason, Out-U is compatible with another potentially problematic case for those who take attributions of understanding to be task-relative, to wit, the case of dyslexic agents. Wilkenfeld states the case in the following passage:

> Consider a dyslexic student. Universities (at least in the United States) make special allowances for students with such conditions as dyslexia precisely because it is recognized that they cannot always perform the tasks we come to expect of people who understand the material. One might be cautiously optimistic that there are other tasks one could ask them to perform such that their performance would be reflective of genuine understanding, but it would be foolhardy to claim that this is necessarily or even always actually the case.
>
> [Wilkenfeld 2013: 1012]

Any account of attributions of understanding that ties them too close-

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is necessarily true. That said, it is in principle possible to avoid stating Out-U in terms of a subjunctive conditional. One alternative strategy appeals to the notion of an epistemic duplicate and claims that 'S understands P' is true in a context just in case some epistemic duplicate of S would successfully perform the tasks determined by context. (Thanks to XXX for pointing this out to me.) I decided to opt for the subjunctive version because it strikes me as most intuitive and more elegant certainly than the "epistemic duplicate" version.

ly to abilities to perform certain tasks will struggle to do justice to understanding in dyslexic agents. Out-U, in contrast, handles the case with remarkable ease: dyslexic agents may understand a certain phenomenon even if they are unable to perform any task whatsoever that would be reflective of it. They will do so whenever they know enough about it to be such that they would (be sufficiently likely to) successfully perform the contextually determined set of tasks if they were to have the skills needed to do so and to exercise them in suitably favourable conditions. Since dyslexic agents often enough satisfy this condition, by Out-U, they can truly be attributed understanding in the relevant contexts.

6   Conclusion

In this paper, I have outlined a novel account of understanding. At its basis is an account of degrees of understanding, Max-U and Deg-U, according to which fully comprehensive and maximally well-connected knowledge about a phenomenon constitutes maximal understanding and degrees of understanding are measured in terms of distances to maximal understanding. This account of degrees of understanding is used to give a contextualist semantics for attributions of outright understanding, Out-U, according to which, roughly, an attribution of outright understanding is true if and only if one knows enough to perform a contextually relevant task. I have argued that this account compares favourably with the two main alternative approaches to understanding in the literature, manipulationism and explanationism, as it can secure the benefits of both accounts without incurring the costs of either.

While there is thus reason to believe that the proposed account carries some promise, some issues remain unresolved. One concerns the relation between understanding and explanation. Even Lipton, who acknowledges that one can understand without explanations, grants that there is a close link between understanding and explanation. In his view "explanations set the standard for what kind of knowledge counts as understanding" [Lipton 2009: 54]. On the present account this does not appear to be the case. Given that this is so, the question remains whether the present account can make sense of the link between understanding and explanation. While I do not have a definitive answer to it, here is a line that it might be worth pursuing at this stage. Maximal understanding of a phenomenon requires knowledge of maximally complete and correct explanations of

it. After all, one will not know everything there is to know about a phenomenon if one misses out on a maximally complete and correct explanation of it. Now the crucial hypothesis is that to surpass a certain degree of understanding of a phenomenon, one must know explanations of it. If this is correct, then understanding above a certain degree of quality will require explanation. The link between understanding and explanation would be restored.

Another loose end concerns the idea that understanding requires knowledge. True, we have seen some reason to favour knowledge based accounts of understanding over accounts that allow for representations of all kinds, including imagination-based ones. However, one might think that even if the range of representations that can constitute one's understanding has to be more restrictive than that, it need not be so restrictive as to require knowledge. For instance, one might think that understanding can be constituted for instance by justified belief or justified true belief about a certain phenomenon (see n.11). I think that there is good reason to stick to a knowledge based account of understanding, as I think that only a knowledge based account can make sense of intuitions about comparative degrees of understanding and give a satisfactory account of the aims of scientific and ordinary inquiry. However, I will leave the argument for another occasion.

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