**It Ain’t That Deep:**

**Metaphysics and the Problem of Progress**

***Abstract:*** *In this paper, I present a novel, unifying account of progress across science and metaphysics in terms of deepening explanation. In so doing, I supplement an understanding-based conception of scientific progress with interventionist analyses of both explanatory depth and metaphysical explanation. On the resulting view, progress is made when scientists and metaphysicians grasp explanations of increasing depth, where the depth of an explanation is measured with respect to the range of interventions under which it is invariant. Further, I argue that “correspondence” occurs where this range contains those same interventions under which a prior explanation is invariant. I then apply this notion of progress to a case study concerning two rival metaphysical explanations of the identity and distinctness of concrete objects. I demonstrate that the weak discernibility proposal is progressive with respect to the earlier qualitative properties proposal, precisely because the former remains invariant under a wider range of interventions than the latter. What’s more, since this wider range contains the range of interventions under which the qualitative properties proposal is invariant, these metaphysical theories can meaningfully be said to correspond.*

***Wordcount:*** *7429*

***Keywords:*** *Scientific**progress; Philosophical progress; Explanatory depth; Metaphysical Explanation; Correspondence.*

1. **Introduction:**

In this paper I put forward a novel, *unifying,* account of progress across science and metaphysics. Progress, on my view, is made when both scientists and metaphysicians provide *deepening* explanations of a target phenomenon. In so doing, I utilize a methodology recently put developed by Finnur Dellsén, Insa Lawler & James Norton (2021), who argue that we ought to use science as a “testing ground” for a *general* account of progress, before then applying the resultant notion to philosophy.

While metaphysics might seem like a discipline where such a methodology would prove particularly fruitful, there are reasons to think that such intimal appearances are misleading.[[1]](#footnote-1) While there is widespread pessimism regarding the scope of philosophical progress *tout court*, Kerry McKenzie (2020) has recently argued that the prospects for progress in metaphysics are especially troubling.[[2]](#footnote-2)

The broad consensus among philosophers of science holds that scientific progress is constituted by providing *better approximations to the truth*.[[3]](#footnote-3) According to McKenzie (2020), since the language of approximation cannot be meaningfully applied to metaphysical theses, metaphysics cannot make progress in the same way as science and, as such, we have little reason to think that it makes progress *at all*.

However, I believe that this pessimism is unwarranted, and that a more optimistic attitude can be motivated towards the prospects of progress within metaphysics. My approach builds upon Dellsén, Lawler & Norton’s (2021) ‘testing ground’ methodology in combining Dellsén’s (2016) *noetic* account of scientific progress with interventionist analyses of both *metaphysical* explanation (Schaffer 2017) and explanatory *depth* (Hitchcock & Woodward 2003b). On the resulting thesis, scientific and metaphysical progress is constituted, not by approximation to the truth but, rather, by grasping an explanation which is invariant under a wider range of testing interventions than its predecessor.

Here is the plan. In the next section, I outline McKenzie’s conception of progress and why it leads to pessimism regarding claim that metaphysics is progressive. Crucially, McKenzie argues that the notion of *correspondence*, or “retention through change”, is a necessary component of scientific progress which cannot be replicated within metaphysics. I then present Dellsén’s (2016) alternative account of scientific progress in terms of increasing understanding; my principal interest here, being in the idea that understanding is the cognitive achievement at which *explanation* is directed.[[4]](#footnote-4)

This focus upon understanding makes the question of progress across both science and metaphysics importantly dependent upon the nature of explanation itself. In sections 3, I present my own preferred analysis: the interventionist account popularized by Woodward (2003). This preference is, in no small part, motivated by the concept of *explanatory depth* available to such an account. According to Hitchcock & Woodward (2003b), one explanation is deeper than other insofar as the former remains *invariant* under a wider range of testing interventions than the latter.

It is this notion of depth, which I believe can facilitate a unifying conception of scientific and metaphysical progress. In section 4, I demonstrate how correspondence, and thus progress, can be captured by a scientific explanation being invariant under a wider range of interventions than its predecessor, where this range *contains* those interventions under which the prior theory was invariant. In order to move this depth-based account of progress beyond the ‘testing ground’ of science, in section 5, I use Jonathan Schaffer’s (2017) interventionist account of metaphysical explanation to motivate an analogous notion of explanatory depth operative in the metaphysical domain.[[5]](#footnote-5)

In section 6, I turn my attention to a detailed case study of metaphysical explanation, concerning two rival accounts of the identity and distinctness of concrete objects: the *qualitative properties proposal* (*QPP*)and the *weak discernibility proposal* (*WDP*).[[6]](#footnote-6) On the depth-based account motivated in previous sections, I argue that we can characterize such debate as progressive in the very same sense in which science is progressive.

The *WDP*, I maintain, is progressive with respect to the prior *QPP* because the former theory provides explanations which remain invariant under a wider range of testing interventions than those explanations provided by the latter. What is more, the range of interventions under which the *QPP* is invariant is *strictly contained* within the range of testing interventions under which the *WDP* is invariant.

As a result, this case study suggests that the *noetic* account of progress, combined with interventionist analyses of explanatory depth and metaphysical explanation, not only provide us with a natural way of characterizing progress across both science and metaphysics, but also with a unifying notion of correspondence, or “retention through change”; the very notion which, McKenzie (2020) argues prevents metaphysics from being considered progressive. In section 7, I consider, and subsequently dismiss, two plausible concerns which arise as a result of the unification of scientific and metaphysical progress.

1. **Progress as Understanding:**

In “Thinking About Progress: From Science to Philosophy” Dellsén, Lawler & Norton (2021) note that, to sensibly address the question of whether philosophy makes progress, we must first offer an account of what philosophical progress actually *is* (2012:28). What’s more, they argue that in attempting to provide an account of what *constitutes* progress in philosophy, we ought to pay close attention to analogous debate surrounding the nature and scope of *scientific* progress.[[7]](#footnote-7)

During the 20th century, debate surrounding the nature of scientific progress was dominated by the *semantic* account, which suggests that science progresses by producing increasingly *verisimilitudinous* (or *truthlike*) theories.[[8]](#footnote-8) It is unsurprising then, that it is something like this notion which is adopted by McKenzie (2020), who argues that progress is made when scientific theories provide better *approximations to the truth*.

McKenzie focuses upon one specific feature, apparently necessary for achieving such approximation: the need to reflect the ‘continuity that exists between the central equations of those theories, relations that we call *correspondence*’ (2020:10). In this sense, a new theory must offer a more *refined* description than its predecessors: ‘a theory which has been well corroborated can only be superseded by one [which] *contains* the old, well corroborated theory – or at least a good approximation of it’ (Popper, 1959:276).[[9]](#footnote-9)

Given that the notion of correspondence is defined in terms of the *central equations* of a theory, McKenzie claims that this element of progress does not have any clear analogue outside of mathematicised disciplines (2020:13). As a result, it is difficult to see how metaphysics can capture idea that “retention through change” is a necessary feature of progress.

However, as McKenzie freely admits, the nature of scientific progress is a topic of intense debate (2020:9). Indeed, while the *semantic* account remains popular, a rival realist accounts has recently emerged which, I believe, puts pressure on the idea that metaphysical and scientific progress are necessarily disunified. According to Dellsén’s (2016, 2017, 2018) *noetic* account, science progresses through increasing understanding, defined in terms of scientists “grasping” how to correctly explain or reliably predict more of the world than they could before.[[10]](#footnote-10)

Until recently, there had been a relative consensus among philosophers of science that understanding is merely a *species* of knowledge, knowledge which stands in some privileged relation to explanation.[[11]](#footnote-11) Despite this general agreement within the philosophy of science literature, Stephen R. Grimm notes that ‘virtually every major epistemologist… has come to the conclusion that understanding is *not* a species of knowledge’ (2006:516).[[12]](#footnote-12) Partly as a result of this trend, the landscape of debate surrounding *scientific* understanding has changed dramatically in recent years, with several leading philosophers of science having now broken ranks.

One interesting element of the idea that science progresses through increasing understanding, *rather than* knowledge or approximate truth, is that understanding is not an intrinsically realist notion. Henk de Regt (2015, 2017), for example, has argued for an *anti*realist notion of understanding, which is distinguished from knowledge in not being (even moderately) factive.[[13]](#footnote-13) In contrast, Dellsén takes understanding to be at least *quasi*-factive, suggesting that ‘the explanatorily/predictively essential elements of a theory must be true in order for the theory to provide grounds for understanding’ (2015:73, fn6).[[14]](#footnote-14)

As a result of this quasi-factive character, the noetic account can supposedly accommodate the realist mantra that progress is made by getting closer to the truth, since ‘one’s degree of understanding would simply be determined, at least in part, by how close to a fully correct representation of something is used for explanatory and predictive purposes’ (Dellsén, 2018:10).

What distinguishes understanding from knowledge, according to Dellsén, is rather that the former can be gained absent the *justification* required to possess the latter.[[15]](#footnote-15) For my current purposes, however, these questions about how we differentiate understanding from knowledge can be put to one side. This is because my principal interest in the notion of understanding, as a defining characteristic of progress, comes from an idea that understanding is the cognitive achievement towards which *explanation* is directed.[[16]](#footnote-16)

The idea that understanding is the goal of explanation, and thus an epistemic aim of science, is not new. Indeed, Carl Hempel argues that an explanation enables us to ‘*understand why* the phenomenon occurred’ (1965:337); Michael Friedman, that scientific explanation ‘increases our understanding of the world’ (1974:15); Wesley Salmon, that ‘underlying causal mechanisms hold the key to our understanding of the world’ (1984:260); and Philip Kitcher, that the ‘search for understanding is, on many accounts of science a fundamental goal of the enterprise’ (1989:419).

However, if understanding is the cognitive achievement which results from grasping a correct explanation, it appears to matter a great deal exactly what *explaining* consists of. Just as Dellsén, Lawler & Norton (2021) argue that the question of what constitutes philosophical progress cannot be sensibly addressed without first offering an account of what philosophical progress actually *is*; it appears that the question of what constitutes understanding (across both science and metaphysics) cannot be sensibly addressed without first offering an account of what explanation actually *is.* It is to this task that we shall now turn.

1. **Understanding as Explanation:**

In attempting to utilize Dellsén, Lawler & Norton’s ‘testing ground’ methodology to tie progress to understanding, we will need an account of explanation which can capture instances across both science and metaphysics. Fortunately, recent years have seen an explosion of interest in accounts of explanation which attempt to unify (to a greater or lesser extent) scientific and metaphysical explanation.

A brief review of the literature reveals accounts of metaphysical explanation which utilize: Hempel’s (1965) deductive-nomological framework (e.g., Wilsch 2015, 2016); Friedman (1974) and Kitcher’s (1981, 1989) unificationist frameworks (e.g., Baron & Norton 2018; Kovacs 2019); and the causal-mechanical framework originally developed by Salmon (1984, 1998) (e.g., Trogdon 2018).

Despite the proliferation of options here, when it comes to analyses of explanation within metaphysics, the most popular approach builds upon the *interventionist* analysis of causal explanation, popularized by Woodward (2003) and Hitchcock & Woodward (2003a, 2003b) (e.g., Schaffer 2016, 2017; Wilson 2016, 2018; Reutlinger 2017; Miller & Norton 2021, *forthcoming*). Successful explanation, according to interventionists, is a matter of elucidating patterns of counterfactual dependence ‘describing how the system whose behavior we wish to explain would change under various conditions’ (Hitchcock & Woodward, 2003a:2).

However, a generalization can onlysupport the kinds of counterfactual dependence required for a successful explanation if it is *invariant* under testing interventions. In other words, an explanatory generalization must ‘describe a relationship which holds for certain *hypothetical* values of *X* and *Y possessed by the very object o…* where the value of *X* is changed by an intervention’ (Hitchcock & Woodward, 2003a:20). More formally, *I* is an intervention on *X* iff:

1. *I* causes *X*;
2. *I* acts as a switch for all other variables that cause *X*. That is, certain values of *I* are such that when *I* attains those values, *X* ceases to depend on the values of other variables that cause *X* and instead depends only on the value taken by *I;*
3. Any directed path from *I* to *Y* goes through *X*.That is, *I* does not directly cause *Y* and is not a cause of any causes of *Y* that are distinct from *X* except, of course, for those causes of *Y*, if any, that are built into the *I*→*X→→Y* connection itself; that is, except for (a) any causes of *Y* that are effects of *X* (i.e., variables that are causally between *X*  and *Y*) and (b) any causes of *Y* that are between *I* and *X* and have no effect on *Y* independently of *X*;
4. *I* is (statistically) independent of any variable *Z* that causes *Y* and that is on a direct path that does not go through *X*. (Woodward, 2003:98).

My primary interest in the interventionist account of causal explanation, comes from the accompanying notion of *explanatory depth* which it can provide. Hitchcock & Woodward (2003b) argue that the traditional distinction between laws and accidental generalizations does not do justice to the role which generalizations play in explanation. This distinction involves ‘an exhaustive dichotomy of true generalizations’ – a true generalization is either a universal law, in which case it can facilitate explanations, or it is accidental, in which case it cannot – there are no other options (Hitchcock & Woodward, 2003b:183).

However, by cashing out the explanatory character of generalizations in terms of invariance under testing interventions, we see that ‘[a]mong those generalizations that are invariant, some will be more invariant than others, and they will correspondingly provide *deeper explanations*’ (Hitchcock & Woodward, 2003b:183-184. Italics added). For one explanation to be deeper than another, is for the former to answer a greater range of “*what-if-things-had-been-different-questions*” concerning a target object or system than the latter. Answering such questions, according to Hitchcock & Woodward, tells us what the value of the explanandum variable *depends upon* (2003b:183).

Consider, for example, the laws of Newtonian mechanics, which are highly accurate for objects moving at relatively low velocities. When applied to some object with a velocity that is very small compared to that of light, such generalizations will remain invariant under a range of interventions *R* on that velocity. However, Hitchcock & Woodward note that ‘[t]he special relativistic correction to these laws has two related effects’ (2003b:186).

First, even though Newton’s laws are ‘approximately true’ with respect to *R*, the corrected generalizations will be *more accurate* within *R*. Second, the updated generalizations will be invariant under a *wider range of interventions R\*,* where *R\** strictly contains *R*; but also contains interventions upon objects with velocities closer to that of light. In this sense, the special relativistic corrections to Newtonian mechanics provide for deeper explanations insofar as they remain invariant under a wider range of testing interventions, despite the fact that the latter *are* explanatory within the narrower range *R*.

1. **Correspondence as Range of Invariance:**

Before continuing, it would be worth briefly taking stock of what has been argued so far, and what I will be arguing in the second half of this paper. In section 2, we saw that McKenzie’s account of scientific progress in terms of approximation focuses upon the role of correspondence: the ‘continuity that exists between the central equations of those theories’ (2020:10). However, since this type of “retention through change” is facilitated by the mathematical nature of the language involved, McKenzie argues that it is difficult to see how metaphysics could make progress in the same way.

For what it’s worth, I agree with McKenzie that when progress is defined in terms of better approximations to the truth, and continuity in terms of the central equations of theories, the prospects for progress within metaphysics do not look good. Where McKenzie and I *di*sagree, however, is with respect to the further claim that the *only* ‘interpretation of metaphysical progress to invoke here is in terms of better approximations of the truth as well’ (2020:19).

In section 3, I noted that my own interest in the *noetic* account of scientific progress lies chiefly in the idea that understanding is the cognitive achievement at which explanation is directed; that scientific progress involves the grasping of correct explanations. However, I argued that this position makes the question of what constitutes scientific understanding and thus, scientific progress, importantly dependent upon the precise nature of explanation.

In section 4, I motivated my own preferred analysis of explanation: the interventionist account of Woodward (2003) and Hitchcock & Woodard (2003a, 2003b). Crucially, it is the interventionist notion of *depth* which can facilitate an analogous conception of progress across both science and metaphysics, making sense of the “retention through change” which McKenzie considers central to the prospect of progress in science.

To return to the example from the end of the previous section: clearly the move from Newtonian to relativistic mechanics was a progressive one. For McKenzie, this progress must be cashed out in terms of the central equations of the former being retained as ‘a good approximation’ in the latter (Popper, 1959:276). However, the interventionist analysis of explanation allows us to account for this continuity without appealing to the mathematicised nature of the language involved.

By utilizing Hitchcock & Woodward’s notion of explanatory depth, one can argue that the special relativistic correction to Newtonian mechanics constitutes progress because the explanatory generalizations provided by the former will be invariant under a wider range of testing interventions than those provided by the latter. Thus, relativistic mechanics can be considered progressive insofar as it provides for *deeper explanations* than its predecessor.

While the generalizations supplied by Newtonian mechanics are invariant with respect to some range of interventions *R*, the relativistic correction to these generalizations provides for explanations that are invariant under a wider range of interventions *R\**. Importantly, however, *R\** strictly contains *R*. That is, *R\** includes those interventions contained in *R* (interventions involving velocities that are relatively small compared to that of light) *as well as* additional interventions not contained in *R* (those involving velocities that are closer to that of light). Here then, we have a natural way of understanding the idea of “retention through change” which need not reference the central equations of the theories involved.

In what remains of this paper, I shall argue that progress in metaphysics can be analogously described in terms of metaphysicians’ grasping how to correctly explain more aspects of the world than they could before. Furthermore, I shall argue that in adopting an interventionist account specifically, we can make sense of the idea of correspondence between explanations of both science and metaphysics. *Progress*, on this account, is cashed out in terms of an explanatory generalization being invariant under a wider range of interventions than its predecessor, and *correspondence* in terms of this range, *R\**,containing the range of interventions, *R*, under which the prior theory was invariant.

As noted above, recent years have seen a proliferation of analyses of *metaphysical* explanation in analogy with interventionist accounts of causal explanation. Such approaches suggest that metaphysical explanation, like causal explanation, is linked to the explication of patterns of counterfactual dependence. Indeed, Woodward himself argues that ‘the common element in many forms of explanation, both causal and non-causal, is that they must answer what-if-things-had-been-different questions’ (2003:221). Which is to say, both causal and noncausal explanations ‘are explanatory by virtue of exhibiting how the explanandum counterfactually depends on the explanans’ (Reutlinger, 2017:243).

This connection has led several authors to posit the existence of “law of metaphysics”, which play essentially the same role in metaphysical explanation as natural laws do in causal explanation (Kment, 2014:5). Schaffer, for example, follows Woodward (2003) and Hitchcock & Woodward (2003a, 2003b) in arguing that such laws ‘need not be fundamental or exceptionless’, but can be minimally understood as ‘counterfactual-supporting general principal[s]… operative in the metaphysical realm’ (2017:305). In the next section, I argue that Schaffer’s (2017) interventionist analysis of metaphysical explanation provides us with all of the necessary tools to motivate an analogous notion of explanatory depth operative in the metaphysical realm.

1. **Explanatory Depth in Metaphysics:**

Schaffer (2017) argues that both causal and metaphysical explanations are characterized by three central roles. The first role (although not necessarily the most important) is to reveal patterns and unify phenomena. Jaegwon Kim, for example argues that dependence relations ‘reduce the number of independent events, states, facts, and properties we need to recognize… Unity and structure go hand in hand; dependence enhances unity by generating structure’ (1994:68). As such, the unificatory role of explanation clearly calls for generalizations which are counterfactually robust, in so far as they ‘serve to subsume a given case under a more general pattern’ (Schaffer, 2017:306). [[17]](#footnote-17)

The second unifying role of causal and metaphysical explanation according to Schaffer, ‘can be seen as connected to Woodward’s (2003) guiding conception of explanations as serving to answer “what if things had been different questions’ (2017:306). As we have already seen, this *manipulationist* role of explanation also requires explanatory generalizations to be counterfactually robust or, in the parlance of Hitchcock & Woodward (2003a), *invariant under testing interventions*.

The final role of explanation is that of providing ‘a basis for understanding the phenomena and so dispel wonderment and offer illumination’ (Schaffer, 2017:306). Here Schaffer argues, once again, that counterfactual supporting general principles are necessary to make sense of the role of explanation in understanding. According to Baumberger, Beisbart & Brum (2017) for example, knowing that *p* because *q* requires both a grasp of the underlying causal principal involved, and of *counterfactual variations*.

Given the ‘far-reaching structural analogy’ which exists between metaphysical and causal explanation (Kment, 2014:5), it ought to come as some surprise that an analogous notion of explanatory depth, operative in the metaphysical domain, remains unexplored. This becomes more puzzlingly still, when we note that Schaffer’s account appears to provide us with all of the tools necessary to be able classify metaphysical explanations in terms of their depth.

Schaffer recognizes that metaphysical explanation requires generalizations, but that such generalizations needn’t be fundamental or exceptionless. Rather, what is required for a metaphysical generalization to be explanatory is that it support an appropriate pattern of counterfactuals, since ‘it is through counterfactual-supporting generalizations that one can calculate the impact of potential interventions’ (Schaffer, 2017:306).[[18]](#footnote-18)

In other words, as with causal explanation, metaphysical explanation requires generalizations which remain invariant under testing interventions.From here, the step to arrive at a notion of *metaphysical* explanatory depth is a small one. As with causal explanation, for one metaphysical explanation to be deeper than another, is for the corresponding generalization to be invariant under a wider range of testing interventions than a rival.

Consider, for example, the fact that Elon Musk is a billionaire. One might well wonder what makes this the case, or what *grounds* Musk’s being a billionaire.[[19]](#footnote-19) A natural response might be to simply highlight the fact that his net-worth is, at time of writing, $250B; although, an intuitively deeper explanation would cite the fact that his net worth is ≥$1B. To assess the comparative depths of these explanations, we need to consider the range of testing interventions under which the corresponding generalizations will remains invariant:

1. *For any person x, if x has a net worth of $250B, then x is a billionaire.*
2. *For any person x, if x has a net worth of* ≥*$1B, then x is a billionaire.*

Imagine a scenario in which Tesla’s share price falls, and Musk’s net worth summarily drops to a measly $150B. In this case, it appears that (a) no longer explains why Musk is a billionaire, since his net worth is not $250B. In other words, (a) will not be invariant under interventions which result in a change in Musk’s net worth and, as a result, this explanation ought to be considered comparatively shallow. On the other hand, (b) will remain invariant under any intervention which results in Musk’s net worth being ≥$1B. As such, it is clear that (b) is invariant under a much wider range of testing interventions than (a), and thus provides a significantly deeper metaphysical explanation of the target phenomenon.[[20]](#footnote-20)

I appreciate that this toy-example does little to help establish the idea that *progress* within metaphysics can be understood in terms of metaphysicians “grasping” deepening explanations. However, what it *does* do, is motivate the idea that there is a notion of explanatory depth operative within the domain of metaphysics, which is analogous to that developed by Hitchcock & Woodward (2003b) with respect to explanation in the causal domain. To see how this notion might be invoked to solve the problem of *progress* within metaphysics, we will need to look at a case of contemporary metaphysical debate in much more detail.

1. **A Case Study of Progress Within Metaphysics:**

In “Explaining Identity and Distinctness”, Erica Shumener (2020) attempts to provide a novel metaphysical explanation of the identity and distinctness of concrete objects. Before presenting her own account in terms of “quantitative properties”, Shumener highlights two prior proposals which are now widely regarded to be unsuccessful.[[21]](#footnote-21) The first, the *qualitative properties proposal* (*QPP*)suggests that identity facts of the form [*x* = *y*] are explained by the fact that *x* and *y* share all of their qualitative properties (e.g., Black 1952; Rocca 2005).[[22]](#footnote-22) The second, the *weak discernibility proposal* (WDP)suggests that such identity facts are explained by the fact that *x* and *y* stand in only *reflexive* relations to one another (e.g., Saunders 2006).

1. **The qualitative properties proposal***:* *for any objects x and y, if x and y share all of their qualitative features, then x is identical to y; and if x has some qualitative feature that y lacks, then x and y are distinct.*
2. **The weak discernibility proposal**: *for any objects x and y, if x and y only stand in reflexive relations to one another, then x is identical to y; and if x stands in an irreflexive relation to y, then x and y are distinct.*

By adopting an interventionist analysis of explanation, and the corresponding notion of explanatory depth put forward by Hitchcock & Woodward (2003b), I believe that we can provide a satisfying account of why the *WDP* ought to be considered *progressive* with respect to the prior *QPP*: because (d) provides us with a deeper explanation of the identity and distinctness of concrete objects than (c).

In order to show this, we require a counterfactual scenario which demonstrates that it’s possible for qualitatively identical objects to be numerically distinct. This scenario will be one in which the generalization specified by the *QPP* is not invariant. Additionally, however, this scenario must be one in which the objects involved stand in only reflexive relations to one another; thus securing the invariance of the generalization specified by the *WDP.*

Max Black (1952) has popularized just such a scenario. First, imagine a possible world which contains only two spatially separated objects, *A* and *B*, which possess different qualitative properties. Let us suppose, for the sake of argument, that *A* is spherical, while *B* is cuboid. It appears that the *QPP* does provide an explanation of the distinctness of *A* and *B* here. (c) suggests that if *A* and *B* share all of their qualitative properties, then they are identical; and that if *A* has some quality which *B* lacks, then they are distinct. Since *A* possesses the quality ‘being spherical’, which *B* lacks, (c) will be invariant under interventions resulting in qualitatively discernible, spatially separated objects.

Now imagine that we intervene upon *A* or *B* (or both), altering them to ensure that they share all of their qualitative properties. They are, in other words, indistinguishable in terms of their qualitative properties (size, shape, mass etc). Under such an intervention, (c) is violated. Since *A* no longer possess any qualitative property which *B* lacks, according to the *QPP*, *A* and *B* are identical. Yet, given that the objects in his case remain spatially separated, we know that they are distinct. As such, (c) is *not* invariant under testing interventions resulting in qualitatively indiscernible, spatially separated objects.

However, as Simon Saunders (2006) argues, the generalization specified by the *WDP* will remains invariant in such cases. According to (d), *A* and *B* would be identical if they only stood in *reflexive* relations to one another, and distinct if *A* stood in at least one *irreflexive* relation to *B*. While all of the qualitative relations which *A* and *B* stand in are reflexive, ‘the spheres [also] stand in irreflexive relations like *five meters away from* to one another’ (Shumener, 2020:2080). Consequently, it appears that (d) remains invariant under testing interventions which violate (c); i.e., those resulting in qualitatively *in*discernible, spatially separated objects.

At the end of section 6, I argued that an interventionist analysis of explanation allows us to account for scientific progress and crucially, the *correspondence* between progressive theories, without the need to appeal to the mathematicised nature of the language involved. By utilizing Hitchcock & Woodward’s (2003b) notion of explanatory depth, I suggested that special relativistic mechanics can naturally be seen as progressive with respect to Newtonian mechanics because the generalizations provided by the former are invariant under a wider range of testing interventions than the latter.

The *continuity* between these theories, the necessary “retention through change”, can then be captured by noting that the range of testing interventions, *R\**, under which the special relativistic corrections are invariant, will *strictly contain* the range of testing interventions, *R*, under which Newton’s laws are invariant. The same appears to be the case with respect to the example of *metaphysical* explanation discussed in this section.

The generalizations supplied by the *QPP* are invariant with respect to a range of interventions *R*, where *R* includes interventions resulting in qualitatively discernible, spatially separated objects. However, the *WDP* provides for explanatory generalizations which are invariant under a wider range of testing interventions *R\**, where *R\** contains *R,* *in addition* to interventions resulting in qualitatively *in*discernible, spatially separated objects.

The *WDP* can thus be considered progressive with respect to the prior *QPP* for the very same reason that relativistic mechanics can be considered progressive with respect to Newtonian mechanics: the former theory is invariant under a wider range of testing interventions that the latter, and thus constitutes *deepening* explanation. What’s more, the range of interventions (*R\**) under which (d) is invariant (those resulting in spatially separated, qualitatively indiscernible objects), *contains* the range of interventions (*R*) under which (c) is invariant (those resulting in spatially separated, qualitatively discernible objects). As a result,the *QPP* and the *WDP* can be said to *correspond.*

Here then, not only do we have a natural way of characterizing progress across both science and metaphysics, but also an analogous way to cash out a notion of “retention through change”; a notion for which metaphysics has no analogue, according to McKenzie (2020).

1. **Objections and replies:**

Having now presented the core argument of this paper, in this section, I want to briefly address two familiar problems which seemingly trouble my account of progress in terms of deepening explanation. I say “familiar” because both concerns originally arose with respect to scientific progress. Given how closely I have tied progress across these two disciplines, one might worry that they now carry across to metaphysical progress too. The first suggests is that the cases presented above represent a dramatic oversimplification of the often-messy business of progress-making. And the second, suggest that on my account progress appears to involve showing prior explanations to be *false*, rather than merely *shallower* than their progressive counterparts.

In the first instance, *Kuhn-loss* is an archetypal example of the sort of complexity which can cause trouble when trying to pin down a notion of scientific progress. Kuhn (1962) famously argued that while there is progress through scientific revolution because a new paradigm will solve *more* problems than its predecessor, a progressive theory need not solve *all* of the problems solved by a prior theory.[[23]](#footnote-23) As an example, Alexander Bird (2007) highlights Descartes’ account of the co-planar orbits of the known planets; a phenomenon for which Newtonian mechanics gives no explanation.

Given how closely I have tied metaphysical progress to scientific progress, it is entirely plausible that analogous cases can be constructed with respect to progress within metaphysics. For example, perhaps there are interventions (in addition to those already discussed) under which the *QPP* remains invariant, yet the *WDP* does not, despite my claim that the latter is progressive with respect to the former. The question is: what are we to make of claims of progress in the face of such instances of apparent *loss* of depth?

One natural way to account for progress in the face of a loss of problem-solving power in a specific area, is to argue that problem-solving power in other areas *makes up* for this (e.g. Laudan 1977). [[24]](#footnote-24) In the parlance of my depth-based account of progress, while *R\** may well contain only a *subset* of those interventions contained within *R*, such loss in invariance will be countered so long as the overall range of invariance *R\** is wider than *R*. Which is to say, so long as the *WDP* is invariant under a widerrange of interventions than the *QPP*, we can cope with *some* interventions under which the latter remains invariant while the former does not. Here then we have an account of *overall* progress in terms of explanatory depth, despite the *loss* of explanatory depth (and thus progress) in in specific areas.

It is also worth highlighting that, even if it turned out that the *QPP* is invariant under a *wider* range of interventions than the *WDP*, this would not necessarily undermine a depth-based account of progress. All that this would show is that we are currently mistaken with respect to *which* explanations of the identity and distinctness of concrete objects are invariant under the widest range of testing intervention, and thus which theory ought to count as progressive. However, it would *not* show that invariance under testing interventions mischaracterizes explanatory depth, nor that explanatory depth mischaracterizes progress.[[25]](#footnote-25)

The second worry concerns an apparent disanalogy between scientific and metaphysical progress as I have described them. In the metaphysical case specifically, it might appear that moving from the *QPP* to the *WDP* involves showing the former theory to be *false*, rather than merely shallower than the latter. Doesn’t this suggest that it is simply misguided to think of (c) as an *explanatory* generalization at all? I think not.

As I noted at the beginning of this section, this apparent problem for my depth-based account of metaphysical progress also arises with respect to scientific progress and, what’s more, the same defence can be mounted. Returning to Hitchcock & Woodward’s (2003b) example, while Newton’s laws are “approximately true” with respect to *R*, it nonetheless seems that showing relativistic mechanics to be invariant under a wider range of interventions *R\**, also involves showing Newton’s laws to be, strictly speaking, *false*.

Yet, this fact doesn’t undermine the explanatory status of Newton’s laws with respect to *R*. Despite relativistic mechanics clearly constituting an instance of progress, Newton’s laws will often strike the right balance between explanatory adequacy and simplicity; where utilizing the special relativistic corrections would prove unnecessarily time consuming or computationally costly for the specificity required by a given explanation.

Similarly, when it comes to explaining the distinctness of our original, qualitatively discernible objects, appealing to reflexive/irreflexive properties is surplus to our explanatory requirements. However, I maintain that this does nothing to undermine the claim that either relativistic mechanics or the *WDP* provides *deeper* explanations than Newtonian mechanics or the *QPP*. Sometimes, in both science and metaphysics, shallow explanations are all that is required.

**Concluding Remarks:**

In this paper, I have argued that we can utilize Dellsén, Lawler & Norton’s (2021) ‘testing ground’ methodology to provide a novel, unifying account of progress across both science and metaphysics. In so doing, I have adopted and adapted Dellsén’s own *noetic* account of scientific progress, which suggests that progress is made when *understanding* increases. However, this is not where the true novelty of my approach lies. Said novelty comes, rather, from idea that a scientific or metaphysical theory is progressive insofar as it provides for *deepening explanation.*

As was noted in section 3, my primary interest in the *noetic* account of scientific progress concerns the claim that understanding is the cognitive achievement at which *explanation*is directed. I also argued that connecting progress to explanation through understanding in this way appears to make the question of “what constitutes progress?” importantly dependent upon the nature of explanation itself. On the interventionist analysis of explanation which I have favoured, to explain a phenomenon, in both science and metaphysics, is to elucidate the systematic pattern of counterfactual dependence linking the explanans to the explanandum.

In combination, these positions provide us with a novel notion of progress upon which a scientific or metaphysical theory is progressive if it provides a *deeper* explanation of a given phenomenon than its predecessor, where depth is measured with respect to an explanation’s range of invariance under testing interventions. What’s more, I have shown, *contra* McKenzie (2020), that this depth-based approach can provide an account of correspondence, or the sense in which theoretical successes are *retained through change*, across both science and metaphysics. One theory can be said to “correspond” with another to the extent that the explanations which it provides are invariant under a range of interventions *R\**, where *R\** contains (at least a subset of) the range of interventions*, R,* under which explanations provided by a prior theory are invariant.

References

Achinstein, P. (1983). *The Nature of Explanation*. Oxford: Oxford University Press.

Bangu, S. (2015). Why does Water Boil? Fictions in Scientific Explanation. In U. Mäki (ed.), Recent Developments in the Philosophy of Science (319-330). New York: Springer.

Baron, S. & Norton, J. (2019). Metaphysical Explanation: The Kitcher Picture. *Erkenntnis* 86 (1):187-207.

Baumberger, C. Beisbart, C. & Brun, C. (2017). What is Understanding? An Overview of Recent Debates in Epistemology and Philosophy of Science. In S. Grimm, C. Baumberger & S. Ammon (eds.), *Explaining Understanding: New Perspectives from Epistemology and Philosophy of Science* (1-34). New York & London: Routledge

Bird, A. (2007). What is scientific progress? Noûs 41 (1):64-89.

Black, M. (1952). The Identity of Indiscernibles. *Mind* 61 (242):153-164.

Bourget, D. & Chalmers, D. (2014). What do philosophers believe? *Philosophical Studies*,  
*170* (3):465-500.

Boyd, R. N. (1983). On the Current Status of the Issue of Scientific Realism. *Erkenntnis*19 (1-3):45-90.

Cevolani, G. & Tambolo, L. (2013). Progress as Approximation to the Truth: A defence of the Verisimilitudinarian Approach. Erkenntnis 78 (4):921-935.

Chalmers, D. (2015). Why isn’t there more progress in philosophy? *Philosophy*, *90* (1):3-31.

Collingwood, R. (1956) *The Idea of History.* New York: Oxford University Press

Dellsén, F. (2016). Scientific progress: Knowledge versus understanding. Studies in History and Philosophy of Science Part A 56:72-83.

Dellsén, F. (2017). Understanding without Justification or Belief. Ratio 30 (3):239-254.

Dellsén, F. (2018). Scientific Progress: Four Accounts. Philosophy Compass 13 (11):e12525.

Dellsén, F. Lawler, I. & Norton, J. (2021). Thinking about Progress: From Science to Philosophy. Noûs <https://doi.org/10.1111/nous.12383>.

de Regt, H., W. (2015). Scientific understanding: truth or dare? Synthese 192 (12):3781-3797.

de Regt, H. W. (2017). Understanding Scientific Understanding. Oxford: Oxford University Press.

Dietrich, E. (2011). There is no progress in philosophy. *Essays in Philosophy* 12 (2):330-345.

Elgin, C. (1996). Considered Judgement. Princeton: Princeton University Press.

Elgin, C. (2004). True Enough. Philosophical Issues 14 (1):113-131.

Elgin, C. (2007). Understanding and the facts. Philosophical Studies 132 (1):33-42.

Emmerson, N. (2021). A Defense of Manipulationist Noncausal Explanation: The Case for Intervention Liberalism. Ekenntnis https://doi.org/10.1007/s10670-021-00497-4.

Emmerson, N. (forthcoming). Understanding and Scientific Progress: Lessons from Epistemology. *Synthese.*

French, S. & Saatsi, J. (2018). Symmetries and Explanatory Dependencies in Physics. In Alexander Reutlinger & Juha Saatsi (eds) *Explanation Beyond Causation: Philosophical Perspectives on Non-Causal Explanations*. Oxford: Oxford University Press. 185-205.

Friedman, M. (1974). Explanation and Scientific Understanding. *Journal of Philosophy* 71 (1):5-19.

Gardiner, G. (2012). Understanding, Integration, and Epistemic Value. Acta Analytica 27 (2):163-181.

Goebel, C. (2019). A Hybrid Account of Scientific Progress: Finding Middle Ground Between the Epistemic and the Noetic Accounts. Kriterion – Journal of Philosophy 33 (3):1-16.

Grimm, S. R. (2006). Is understanding a species of knowledge? *British Journal for the Philosophy of Science* 57 (3):515-535.

Grimm, S. R. (2010). The Goal of Explanation. *Studies in the History and Philosophy of Science Part A* 41 (4):337-344.

Grimm, S. R. (2014). Understanding as Knowledge of Causes. In A. Fairweather (ed.), *Virtue Epistemology Naturalized* (vol 336:1-22). Synthese Library (Studies in Epistemology, Logic, Methodology and Philosophy of Science).

Hempel, C. (1965). *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science.* New York: The Free Press.

Hills, A. (2009). Moral Testimony and Moral Epistemology. *Ethics* 120 (1):94-127.

Hills, A. (2015). Understanding Why. Noûs 49 (2):661-688 (2015)

Hitchcock, C. & Woodward, J. (2003a). Explanatory Generalizations, Part I: A Counterfactual Account. *Noûs* 37 (1):1-24.

Hitchcock, C. & Woodward, J. (2003b). Explanatory Generalizations, Part II: Plumbing Explanatory Depth. *Noûs* 37 (2):181–199.

Horwich, P. (2012). *Wittgenstein’s Metaphilosophy*. Oxford: Oxford University Press.

Jansson, L. & Saatsi, J. (2019). Explanatory Abstractness. *British Journal for the Philosophy of Science* 70 (3):817-844.

Jones, W. (2017). Philosophy, progress, and identity. In R. Blackford & D. Broderick (Eds.), *Philosophy’s Future. The Problem of Philosophical Progress* (227-239).  
Hoboken: Wiley Blackwell.

Khalifa, K. (2013). Understanding, Grasping, and Luck. *Episteme* 10:1-17.

Khalifa, K., Doble, G., & Millson, J. (2020). Counterfactuals and Explanatory Pluralism. *British Journal for the Philosophy of Science* 71 (4):1439-1460.

Kim, J. (1994). Explanatory Knowledge and Metaphysical Dependence. *Philosophical Issues* 5:51-69.

Kitcher, P. (1981). Explanatory Unification. *Philosophy of Science* 48 (4):507-531.

Kitcher, P. (1989). Explanatory unification and the causal structure of the world. In P. Kitcher & W. Salmon (eds.), *Scientific Explanation* (410-505). Minneapolis: University of Minnesota Press.

Kitcher, P. (2002). Scientific Knowledge. In Moser (ed.), *The Oxford Handbook of Epistemology* (385-408). Oxford: Oxford University Press.

Kovacs, D. M. (2020). Metaphysically Explanatory Unification. *Philosophical Studies* 177 (6):1659-1683.

Kment, B. (2014). *Modality and Explanatory Reasoning*. Oxford: Oxford University Press.

Kuhn, T., S. (1962). *The Structure of Scientific Revolutions.* Chicago: University of Chicago Press.

Kuipers, T. (2009). Empirical progress and truth approximation by the ’hypothetico-probabilistic method’. *Erkenntnis* 70 (3):313-330.

Kvanvig, J. L. (2003). *The Value of Knowledge and the Pursuit of Understanding.* Cambridge: Cambridge University Press.

Kvanvig, J. L. (2009). The value of understanding. In Pritchard, Haddock & Millar (eds.), *Epistemic Value.* Oxford: Oxford University Press.

Ladyman, J. & Ross, D. (2007). *Every Thing Must Go: Metaphysics Naturalized*. Oxford: Oxford University Press.

Lange, M. (2019). Asymmetry as a challenge to counterfactual accounts of non-causal explanation. *Synthese* 1-26: https://doi.org/10.1007/s11229-019-02317-3.

Laudan, L. (1977). Progress and its Problems: Toward a Theory of Scientific Growth. Berkeley: University of California Press.

Lipton, P. (2003). *Inference to the Best Explanation*. New York & London: Routledge.

Maurin, A. (2019). Grounding and Metaphysical Explanation: It’s Complicated. *Philosophical Studies* 176 (6):1573-1594.

McKenzie, K. (2020). A Curse on Both Houses: Naturalistic Versus A Priori Metaphysics and the Problem of Progress. *Res Philosophica* 97 (1):1-29.

Miller, K. & Norton (2021). *Everyday Metaphysical Explanation*. Oxford: Oxford University Press.

Miller, K. & Norton, J. (*forthcoming*). Non-cognitivism about Metaphysical Explanation. *Analytic Philosophy.*

Mizrahi, M. (2013). What is Scientific Progress? Lessons from Scientific Practice. *Zeitschrift für Allgemeine Wissenschaftstheorie* 44 (2):375-390.

Niiniluoto, I. (1984). *Is Science Progressive?* New York: Springer.

Niiniluoto, I. (1987). Is Science Progressive? *British Journal for the Philosophy of Science* 38 (2):272-276.

Niiniluoto, I. (1999). *Critical Scientific Realism.* Oxford: Oxford University Press.

Niiniluoto, I. (2014). Scientific progress as increasing verisimilitude. *Studies in the History and Philosophy of Science Part A* 46:73-77.

Oddie, G. (1986). *Likeness to Truth*. Dordrecht: Reidel.

Popper, K. (1959). *The Logic of Scientific Discovery.* London: Hutchinson.

Popper, K. (1962). *Conjectures and Refutations*. New York & London: Routledge.

Potochnik, A. (2017). *Idealization and the Aims of Science*. Chicago: Chicago University Press.

Pritchard, D. (2008). Knowing the answer, understanding and epistemic value. *Grazer Philosophische Studien* 77 (1):325-339.

Pritchard, D. (2010). The Nature and Value of Knowledge: Three Investigations. Oxford: Oxford University Press.

Raven, M. J. (2015). Ground. *Philosophy Compass* 10 (5):322-333.

Rescher, N. (2014). *Philosophical Progress: And Other Philosophical Studies*. Berlin: De  
Gruyter

Reutlinger, A. (2016). Is There a Monist Theory of Causal and Non-Causal Explanations? The Counterfactual Theory of Scientific Explanation. *Philosophy of Science* 83 (5):733-745.

Reutlinger, A. (2017). Does the Counterfactual Theory of Explanation Apply to Non-Causal Explanation in Metaphysics? *European Journal for Philosophy of Science* 1-18.

Rocca, M. (2005). Two Spheres, Twenty Spheres, and the Identity of Indiscernibles. *Pacific Philosophical Quarterly* 86 (4):480-492.

Saatsi, J. & Pexton, M. (2013). Reassessing Woodward’s Account of Explanation: Regularities, Counterfactuals, and Noncausal Explanations. *Philosophy of Science* 80 (5):613-623.

Salmon, W. C. (1984). Scientific Explanation and the Causal Structure of the World. Princeton: Princeton University Press.

Salmon, W. C. (1989). 4 decades of scientific explanation. *Minnesota Studies in the Philosophy of Science* 13:3-219.

Saunders, S. (2006). Are Quantum Particles Objects? *Analysis* 66 (1):52-63.

Schaffer, J. (2017). Laws for Metaphysical Explanation. *Philosophical Studies* 27 (1):303-321.

Shand, J. (2017). Philosophy makes no progress, so what is the point of it? *Metaphilosophy* 48 (3):284-295.

Shumener, E. (2020). Explaining Identity and Distinctness. *Philosophical Studies* 177 (7):2073-2096.

Slezak, P. (2018). Is there progress in philosophy? The case for taking history seriously.  
*Philosophy* 93 (4):529-555.

Sliwa, P. (2015). Understanding and Knowing. *Proceedings of the Aristotelian Society* 115:57-74.

Sterba, J. (2004). *The Triumph of Practice Over Theory in Ethics*. Oxford: Oxford  
University Press.

Thompson, N. (2016). Grounding and Metaphysical Explanation. *Proceedings of the Aristotelian Society* 116 (3):395-402.

Trogdon, K. (2018). Grounding-mechanical Explanation. *Philosophical Studies* 175 (6): 1289-1309.

Wilkenfeld, D. (2013). Understanding as Representation Manipulation. *Synthese* 190 (6):997-1016.

Wilsch, T. (2015). The Nomological Account of Ground. *Philosophical Studies* 172 (12): 3293-3312.

Wilsch, T. (2016). The Deductive-Nomological Account of Metaphysical Explanation. *Australasian Journal of Philosophy* 94 (1):1-23.

Wilson, A. (2016). Grounding Entails Counterpossible Non-Triviality. *Philosophy and Phenomenological Research* 92 (3):716-728.

Wilson, A. (2018). Metaphysical causation. *Noûs* 50 (4):1-29.

Woodward, J. (2003). *Making Things Happen: A Theory of Causal Explanation.* Oxford: Oxford University Press.

Zagzebski, L. (2001). Recovering Understanding. In Steup (ed.), *Knowledge, Truth, and Duty: Essays on Epistemic Justification, Responsibility, and Virtue* (235-252). Oxford: Oxford University Press.

1. James Ladyman and Don Ross, for example, argue that ‘to the extent that metaphysics is closely motivated by science, we should expect to make progress in metaphysics iff we can make progress in science’ (2007:35). [↑](#footnote-ref-1)
2. Pessimistic responses to the question of philosophical progress typically focus upon either: the apparent lack of consensus within philosophy (see e.g., Horwich 2012; Bourget & Chalmers 2014; Rescher 2014; Chalmers 2015; Shand 2017); or the fact that philosophical theories are rarely superseded (and thus discarded) in the way that scientific theories often are (see e.g, Sterba 2004; Dietrich 2011; Jones 2017; Slezak 2018). [↑](#footnote-ref-2)
3. See e.g., Popper (1959, 1962); Niiniluoto (1980, 1984, 1987, 2014); Boyd (1983); Oddie (1986); Kuipers (2009); Cevolani & Tambolo (2013). [↑](#footnote-ref-3)
4. Also see e.g., Bangu (2015); Potochnik (2017); Goebel (2019). [↑](#footnote-ref-4)
5. Also see e.g., Wilson (2016, 2018); Reutlinger (2017) and Miller & Norton (2021, *forthcoming*). [↑](#footnote-ref-5)
6. This example is taken, with thanks, from Shumener (2020). [↑](#footnote-ref-6)
7. The question of what *constitutes* scientific progress, has been labelled the “*conceptual* question” by Niiniluoto (1980), and is distinguished from the “*factual* question” (whether or not science actually makes progress) and a third “*methodological”* or “*epistemological* question” which concerns how we identify progress such as there is. My principal focus in this paper will be on the conceptual question with respect to both philosophy and science. [↑](#footnote-ref-7)
8. See e.g., Popper (1959, 1962); Niiniluoto (1980, 1984, 1999, 2014). [↑](#footnote-ref-8)
9. McKenzie highlights the transition from Galilean to special relativity as a paradigmatic example of what ‘Post termed the *generalized correspondence principle*: the doctrine that old and new theories are virtually always retained as approximations of the new’ (2020:11). [↑](#footnote-ref-9)
10. The idea that “grasping” is the psychological notion necessary in order to achieve understanding is commonplace. As Dellsén himself understands it, “grasping” involves the ability to ‘infer, explain, or mentally manipulate, which extends not just to actual circumstances but also to various counterfactual circumstances’ (2016:75). Also see e.g., Kvanvig (2003, 2009); Grimm (2006, 2010, 2014); Khalifa (2013); Wilkenfeld (2013); Hills (2015). The precise notion of grasping at issue here will have little impact upon the overall argument of this paper. [↑](#footnote-ref-10)
11. See e.g., Achinstein (1983); Salmon (1989); Kitcher (2002); Woodward (2003); Lipton (2003); Grimm (2006, 2010, 2014); Bird (2007). [↑](#footnote-ref-11)
12. See e.g., Elgin (1996, 2004, 2007); Zagzebski (2001); and Kvanvig (2003, 2009). Pritchard (2008, 2010); Gardiner (2012); and Mizrahi (2012). Grimm (2006) and Sliwa (2015) are notable exceptions to this rule. [↑](#footnote-ref-12)
13. De Regt argues that understanding is a matter of *intelligibility*; the ability to use and manipulate a model ‘in order to make inferences about the system, to predict and control its behavior’ (2015:3791). [↑](#footnote-ref-13)
14. While most epistemologists agree with Dellsén in taking understanding to be quasi-factive (e.g., Kvanvig 2003, 2009; Mizrahi 2012; Wilkenfeld 2013), there are some who take understanding to require *fully* factivity (e.g., Grimm 2006; Hills 2009; Pritchard 2010). [↑](#footnote-ref-14)
15. In a recent paper Emmerson (2021) argues that the idea that scientific knowledge and understanding are separable is untannable given the role of justification in scientific practice (also see, Park 2017 and Wilkenfeld 2017). However, for the purposes of this paper, nothing will hang upon these broader debates within epistemology. [↑](#footnote-ref-15)
16. This is not to say that those who take understanding to be a species of knowledge can’t also accept that understanding is the aim of explanation; many do. Grimm, for example similarly argues that ‘the goal of these why-questions – the goal of these inquiries – is understanding’ (2010:337). What this suggests is that a knowledge-based account of scientific progress, like that of Bird (2007), would likely also be able to accommodate the depth-based analysis of correspondence, and thus progress, put forward in this paper. By focusing upon the role of explanation specifically, I have attempted to hedge my bets with respect to these broader epistemological controversies. I take it to be a benefit of my account that whatever the eventual outcome of these debates, either side ought to be able to supplement their preferred notion of understanding with a unifying depth-based analysis of progress and correspondence. [↑](#footnote-ref-16)
17. It is important to note that although Schaffer suggests that such accounts ‘have a plausible motivation’, he also argues that they are unlikely to be correct, owing to their failure to ‘capture the asymmetry of explanation (2017:306). [↑](#footnote-ref-17)
18. It is worth highting that some, recently labelled “intervention-puritans” by Emmerson (2021), are unconvinced that interventions can play a substantive role in characterizing noncausal explanations (see e.g., Saatsi & Pexton 2013; Jansson 2015; Reutlinger 2016, 2017; French and Saatsi 2018; Lange 2019; Khalifa *et al* 2020. For the purposes of this paper, however, I shall adopt the opposing position “intervention-liberalism” and assume that at least *some* forms of noncausal explanation (including metaphysical explanation) *can* be successfully analysed in terms of interventions. Having said this, I expect that much of what follows could be cashed out in terms of non-interventionist counterfactuals without any significant loss of content. [↑](#footnote-ref-18)
19. The relationship between the notion of grounding and metaphysical explanation is, as Maurin (2019) highlights, a notoriously complicated one (also see e.g., Raven 2015; Thompson 2016; Kovacs 2020). However, nothing argued in this paper will be dependent upon any substantive claims about the connection between grounding and metaphysical explanation [↑](#footnote-ref-19)
20. Strictly speaking of course, neither (a) nor (b), metaphysically explain why Musk is a billionaire by themselves. Both are rather generalizations that *might*, in combination with some facts specifically about Musk, and his net worth, explain his being a billionaire. [↑](#footnote-ref-20)
21. Unfortunately, a critical analysis of Shumener’s *quantitative properties proposal* is beyond the scope of this paper. My interest in Shumener (2020) is not in the novelty of their theory, but rather in the dialectical progression of debate surrounding the identity and distinctness of concrete objects; an intuitive interpretation of which can be given in terms of progression through deepening metaphysical explanations. [↑](#footnote-ref-21)
22. Shumener suggests that qualitative properties are those that ‘do not involve the identity relation or involve specific relations. So, for example, *5km mass, adjacent to, same colors as* are qualitative features’ (2020:2079). [↑](#footnote-ref-22)
23. As an example, Bird (2007) highlights Descartes’ account of the co-planar orbits of the known planets; a phenomenon for which Newtonian mechanics gives no explanation. [↑](#footnote-ref-23)
24. There is, however, dispute about whether problem-solving power can be quantified in such a way that will allow us to individuate and count problem solutions (e.g., Collingwood 1956:329 & 332), and one might think that similar concerns can be levelled against my own depth-based account. It is likely that more would need to be said in order to satisfactorily defend of a depth-based account of progress through loss, although, it is important to note that this problem is not unique to the account offered here. Indeed, it is not immediately clear how one ought to view the role of McKenzie’s (2020) mathematicised conception of correspondence in such cases. After all, Descartes’s account of the co-planar orbits of the known planets was not retained within the *central equations* of Newtonian mechanics. The point here being that, although accounting for such loss of explanatory power might well require some supplementation to the depth-based account of scientific progress outlined herein, this is no less of an issue for rival accounts. [↑](#footnote-ref-24)
25. The sort of cases which would be needed to falsify the account provided above, are those in which some explanation *G\** is invariant under a wider range of testing interventions that *G*, and yet *G* provides the deeper explanation. Unsurprisingly, I do not expect that any such cases exist, and I take the onus to be on the reader to present such cases, supposing they do. [↑](#footnote-ref-25)