



A new circularity in explanations by Humean laws of nature

Marc Lange¹ 

Accepted: 17 January 2023 / Published online: 3 February 2023
© The Author(s), under exclusive licence to Springer Nature B.V. 2023

Abstract

Humean accounts of natural law have long been charged with being unable to account for the laws' explanatory power in science. One form of this objection is to charge Humean accounts with explanatory circularity: a fact in the Humean mosaic helps to explain why some regularity is a law (first premise), but that law, in turn, helps to explain why that mosaic fact holds (second premise). To this objection, Humeans have replied that the explanation in the first premise is metaphysical whereas the explanation in the second premise is scientific, so (since these two varieties of explanation operate very differently) the two explanations cannot be chained together to yield explanatory circularity. This paper presents a new circularity argument that avoids this objection because both explanations in the premises are metaphysical. The new circularity argument also avoids the objection that the contrasts at the point where the two explanations are chained together fail to line up properly. The upshot is to leave the Humean account of law with two unattractive options: to regard scientific explanation under natural law as not constituting genuine explanation at all or to regard the Humean account as involving a vicious explanatory circularity.

Keywords Laws of nature · Scientific explanation · Humeanism · David Lewis

1 Introduction

Humean accounts of natural law, such as Lewis's "Best System Account" (Lewis, 1973:73–77, 1986:ix–xii, 1999), have often been charged with failing to account for the laws' explanatory power in science—a power explicitly recognized by both Humeans (Lewis, 1999:232) and non-Humeans, as well as by scientists themselves (e.g., Weinberg, 1992:28–29). One popular version of this charge is that explanations by Humean laws involve vicious explanatory circularity. Recently, many

✉ Marc Lange
mlange@email.unc.edu

¹ Department of Philosophy, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599-3125, USA

Humeans have replied that the threatened circularity disappears once metaphysical explanation is distinguished from scientific explanation.

In this paper I will uncover a previously unrecognized vicious circularity (or near enough) in scientific explanation by Humean laws.

The circle that Humeanism's opponents have previously emphasized consists of two links, one involving metaphysical explanation and the other involving scientific explanation. Thus, the distinction between these two sorts of explanation promises to dissolve the threat of being able to go clear around the circle and produce disastrous self-explanation. By contrast, in the new circle that I will identify, both links involve metaphysical explanation. Therefore, the distinction between metaphysical and scientific explanation cannot block the threatened circularity.

I will also argue that this new circularity argument avoids other difficulties that have been alleged to plague circularity arguments against Humean accounts of lawhood, such as the failure of the contrasts in the two explanations to line up. The new circularity argument may thus provide a *reductio* of Humean accounts. To avoid deeming the circularity vicious, Humeans must thin down their conception of scientific explanation to such an extent that it may no longer be pretheoretically recognizable as explanatory.

2 A charge of circularity previously brought against Humean accounts of law

Dretske (1977:262) engagingly leveled the charge that Humean accounts of lawhood cannot account for the laws' explanatory power:

To say that a law is a universal truth having explanatory power is like saying that a chair is a breath of air used to seat people. You cannot make a silk purse out of a sow's ear, not even a very good sow's ear; and you cannot *make* a generalization, not even a purely universal generalization, explain its instances. The fact that *every F is G* fails to explain why *any F is G* ... Subsuming an instance under a universal generalization has exactly as much explanatory power as deriving *Q* from *P·Q*. None.

Armstrong (1983:102) echoed this charge. However, as it stands, this charge begs the question against the Humean, as I pointed out in (Lange, 1992). On a Humean account, a law is a universal regularity with some further property that makes it a law rather than an accident. That further property, on Lewis's Best System Account (BSA), is membership in the "best" deductive system of truths: roughly, the system with the optimal combination of simplicity (e.g., in the number and mathematical form of its axioms) and strength (i.e., coverage of the Humean mosaic). That further property of belonging to the Best System (BS) might give a law its explanatory power. (We will shortly see some Humeans arguing that it does.) The argument given by Dretske and Armstrong failed to foreclose this possibility.

Maudlin (2007:172) sharpened the charge against Humean accounts by arguing that for laws to help explain a particular event¹—a tile in the Humean mosaic—would run opposite to the direction of explanatory priority that Humean accounts propose:

If the laws are nothing but generic features of the Humean Mosaic, then there is a sense in which one cannot appeal to those very laws to *explain* the particular features of the Mosaic itself: the laws are what they are in virtue of the Mosaic rather than vice versa.

On behalf of the BSA, Loewer (2012) replied that Maudlin's charge runs together two kinds of explanation: metaphysical and scientific. On a Humean account, a tile in the mosaic is explanatorily prior to the fact that some regularity is a law in terms of *metaphysical* explanation; facts about the mosaic help to ground facts about lawhood. But in terms of *scientific* explanation, the fact that some regularity is a law is explanatorily prior to a tile in the mosaic.

Replying to Loewer, I argued that a transitivity principle links metaphysical and scientific explanations:

For any facts D, E, and F, if E scientifically explains [or helps to scientifically explain] F and D grounds [or helps to ground] E, then D scientifically explains [or helps to scientifically explain] F. (Lange, 2013:256)

With this transitivity principle, I aimed to show in (Lange, 2013) that Lewis's BSA is committed to any ordinary fact in the Humean mosaic helping to scientifically explain itself, which is impossible. For example, let D be the fact that a particular flame at a given time burns yellow. Let E be the fact that it is a law that all flames into which sodium salt has been inserted burn yellow. On the BSA, D helps to metaphysically explain E since D is partly responsible for making the regularity that all sodium-salted flames are yellow not only hold, but also strong enough to earn its way into the BS. Let F be that a given flame burns yellow. E (along with the fact that the flame has been sodium-salted) scientifically explains F. Therefore, by the transitivity principle, D helps to scientifically explain F. But we might just as well let D and F concern the same event of a flame's burning yellow. So D helps to scientifically explain D, violating the prohibition on self-explanation (except, perhaps, in exotic cases). In (Lange, 2013), I argued that this is a *reductio* of the BSA. In short:

1. D(=that a given flame burns yellow) helps to *metaphysically* explain E(=that it is a law that all sodium-salted flames burn yellow).
 2. E helps to *scientifically* explain D.
- Therefore (by transitivity),
3. D helps to *scientifically* explain D (*reductio*).

¹ Since the Humean facts in the mosaic are that various perfectly natural, non-modal, non-dispositional, non-haecceistic, intrinsic properties are instantiated at spacetime points (or by occupants thereof), I will sometimes refer to the mosaic's "events" rather than the "facts" in the mosaic. This should cause no confusion. (Laws, of course, are *not* events.) See note 8.

This argument has attracted too many replies to list here. In (Lange, 2018), I responded to a few of them (Hicks and van Elswyk, 2015; Marshall, 2015; Miller, 2015). One common recent Humean reply (e.g., Bhogal, 2020; Duguid, 2021)² is to reject any transitivity principle (such as the one I used in the above argument from (Lange, 2013)) that purports to deduce D's scientific explanatory relevance to F from premises that include both *metaphysical* explanatory relevance (of D to E) and *scientific* explanatory relevance (of E to F). The objection to any such principle is that on Humean accounts of law, metaphysical and scientific explanation are so fundamentally dissimilar that by stringing them together (as my (2013) transitivity principle does), we do not generally derive a scientific explanation. Let's look closely at how this objection goes (according to Bhogal and Duguid).

On any Humean account, lawhood is a metaphysically lightweight achievement (as compared to the metaphysically heavyweight conception of lawhood under any non-Humean account). Hence, scientific explanation by laws is also metaphysically lightweight—as compared, in particular, to metaphysical explanation. As Bhogal (2020:175) says, “nomic structure isn't a deep part of the world” on the Humean account, since it is merely a summarizing of the Humean mosaic. Whereas metaphysical explanations work by describing the world's ontological structure (e.g., what grounds what), laws scientifically explain by systematizing the facts in the Humean mosaic—in particular, by describing their relations to the BS. The laws, in forming the deductive system with the optimal combination of strength and simplicity, constitute “the pattern that we fit facts into” (Bhogal, 2020:187) in unifying them and thereby scientifically explaining them. Subsumption under the BS scientifically explains by virtue of being the optimal way for a relatively small number of patterns to cover a relatively large number of the facts in the Humean mosaic.

This is (according to Bhogal and Duguid) the source of the laws' scientific explanatory power, on the Humean picture. The Dretske-Armstrong argument failed by neglecting to consider this source. Here we also have the reason why (according to Bhogal and Duguid) the transitivity principle from (Lange, 2013) fails in the cases (such as the sodium-salt case) figuring in my (2013) argument that the Humean account of law leads to disastrous self-explanation. Suppose a fact D about the Humean mosaic helps to *metaphysically* explain a fact E about the laws, where E in turn helps to *scientifically* explain a fact F about the mosaic. It does not follow (according to Bhogal and Duguid) that D helps to scientifically explain F. Rather, we would expect D *not* to help scientifically explain F, under the picture of scientific explanation as unifying as many Humean facts as possible into as few patterns as possible. After all, unlike when a law E helps to scientifically explain an element F of the mosaic, for element D to (allegedly) help scientifically explain F

doesn't help the cause of unification: when we unify, we are trying to reduce the number of phenomena we accept independently by assimilating specific events to more general patterns. But the metaphysical explanation of the laws starts from [i.e., the BSA's metaphysical explanation of the laws' lawhood has

² Later I will also discuss the reply from Hicks 2021. These papers cite some of the other replies.

as its explanandum—ML] general patterns—the laws themselves—and reduces them to large numbers of specific facts—the facts about the mosaic. Clearly this procedure will not help unification. (Bhagal, 2020:178)

That is, by covering F with a law, we place F in a unifying structure arising from a relatively small number of simple regularities. So far, so good as far as scientific explanatory unification is concerned. But we would ruin that unification by breaking the law apart into its constituent mosaic elements. So (contrary to transitivity) D does not acquire any power to *scientifically* explain F by D's helping to *ground* E, a law that helps to scientifically explain F. Unlike E, D isn't any sort of pattern in terms of which we can systematize F.

On this view, the transitivity principle from (Lange, 2013) is spoiled by its mixing D's *metaphysically* explaining E with E's *scientifically* explaining F. Because metaphysical explanation does not operate by anything like unifying the explanandum under a pattern (instead working by tracing the world's heavyweight metaphysical structure), D's *metaphysically* explaining E (which, in turn, scientifically explains F) cannot enable D to help *scientifically* explain F. Duguid (2021:6050) makes the same point:

Suppose that *E* explains *F* by treating it as part of some wider pattern and that *E* is grounded in *D*. There is nothing to guarantee that *D* will be able to explain *F* in the same way as *E* does as patterns evident among the *E*-facts might not be apparent amongst the *D*-facts. ... When a scientific explanation is offered of some instance, that instance is being subsumed into the pattern captured by the law invoked in the explanation. If transitivity held, the instance would also be subsumed into a pattern at the level of the entire mosaic. But the whole mosaic is large and varied; it is not at all clear how it comprises a pattern under which any one instance could be subsumed.

Let's now look at a new circularity argument where *both* premises are *metaphysical* explanations; neither is a scientific explanation. Therefore, a transitivity principle can be applied without begging the question against the Humean unificationist picture of scientific explanation.

3 A new circularity

On the Humean unificationist picture of scientific explanation that Bhagal and Duguid invoke, the laws explain by virtue of constituting a simple, strong network of patterns into which the facts to be explained can be integrated. A law (e.g., that all flames burning sodium salts are yellow) is a pattern in the Humean mosaic that helps explain some events in the mosaic. The fact that this pattern is *a law* (e.g., the fact that *it is a law* that all sodium-salted flames burn yellow) is not itself a scientific explainer of an event in the mosaic. Rather, the pattern's lawhood metaphysically explains why a mosaic event's subsumption under the pattern scientifically explains it. The law's lawhood metaphysically explains the law's scientific explanatory power.

On this picture, then, a tile in the mosaic helps to metaphysically explain a law's lawhood—its membership in the BS. A law's lawhood, in turn, metaphysically explains the law's power to scientifically explain a tile in the mosaic—which could be the same mosaic event with which this chain of explanations began. By transitivity, then, a mosaic event helps to metaphysically explain the law's power to scientifically explain that event itself:

4. D(= that a given flame burns yellow) helps to *metaphysically* explain the fact that it is a law that E(= that all sodium-salted flames burn yellow).

5. That it is a law that E helps to *metaphysically* explain E's power to scientifically explain D.

Therefore (by the transitivity of metaphysical explanation),

6 D helps to *metaphysically* explain E's power to scientifically explain D (*reductio*).

This circularity argument does not use the transitivity principle from (Lange, 2013) and so avoids the objection that we saw my original (2013) circularity argument encounter. The first premise of my (2013) argument was a case of *metaphysical* explanation whereas its second premise and its conclusion (alleging self-explanation) were purported cases of *scientific* explanation. By contrast, both premises of my new circularity argument are cases of *metaphysical* explanation (though one of these explanations metaphysically explains a law's power to give scientific explanations). Whereas the transitivity principle used in my original (2013) argument was deemed to beg the question against the Humean, the transitivity of metaphysical explanation (by contrast) is widely accepted. Nearly all philosophers who work on grounding regard it as a strict ordering: transitive, irreflexive, and anti-symmetric. (See, e.g., Correia, 2010, Fine, 2012, Raven, 2013, and Schaffer, 2012.) So the transitivity assumed by the new circularity argument is relatively uncontroversial. In particular, it does not beg the question against Humeanism; it does not presuppose a non-Humean picture of scientific explanation.

Whereas the conclusion of my (2013) circularity argument involved an event's helping to scientifically explain itself, the conclusion of the new circularity argument is that a given mosaic event helps to metaphysically explain a law's power to scientifically explain that selfsame event. This is not direct self-explanation. But it is still viciously circular for an event to help empower something else to explain that very event. A fact not only cannot (help to) explain itself, but also cannot (help to) explain its explainers or their power to (help) explain it.

In (Lange, 2018:1351–52), I argued that this sort of circularity would be vicious. I did so in the course of arguing that a Humean account of laws still involves vicious circularity even if laws do not themselves explain individual facts in the Humean mosaic, but instead explain why other Humean facts help to explain a given mosaic fact. In defending Humeanism, Hicks (2021:539–40) defends the view that “laws partially explain the explanatory relation between the explanans and explanandum” and thus “although laws do not feature as explanans, they do, in an important sense, back the explanation.” It seems to me, then, that if D helps to explain E's power to explain F, then D, in an important sense (as

Hicks says), backs the explanation of F—and so D cannot *be* the F that is being explained on pain of vicious circularity: D's helping to back the explanation of D.

In Sect. 4, I will critically examine the way that Hicks (2021) attempts to resist my original (2013) circularity argument; I will argue that Hicks's strategy cannot be applied to my new circularity argument. In Sect. 5, I will expand an argument that I have given before (in Lange, 2018:1351–52) in order to demonstrate the viciousness of the sort of circularity invoked in my new circularity argument. In addition, I will look at some Humean objections to this view.

Before doing so, we first need to consider a possible objection to the new circularity argument. For a law E (e.g., that all sodium-salted flames burn yellow) to help scientifically explain a given fact D (e.g., that a given flame burns yellow), D must obtain. In this way, D helps to constitute the fact that E helps to scientifically explain D. So D helps to metaphysically explain E's power to scientifically explain D. But (the objection points out) this arrangement involves nothing problematic—nothing even remotely viciously circular. Moreover, we just reached the conclusion that this arrangement holds unproblematically without appealing to any distinctively Humean premise; a non-Humean about law should accept this line of reasoning, too.

The correct response to this objection is to expose the implicit contrasts to the facts being explained and to the facts doing the explaining. As both Schaffer (2012) and I (2018) have emphasized, these contrasts must line up in order for explanations to be transitive. When (in the above objection to the new circularity argument) D helps to make it the case that the law E helps to scientifically explain D, what D helps to metaphysically explain is why E helps to scientifically explain D *rather than* E not helping to scientifically explain D because not-D is instead the case. This is indeed unproblematic. By contrast, the explanandum in the new circularity argument's conclusion is E's power to explain D *given that E and D are true*. The explanandum, in other words, is E's helping to scientifically explain D *rather than* E&D's being true but E's not helping to scientifically explain D. For D to help metaphysically explain *that* explanandum is indeed problematically circular just like D's directly scientifically explaining itself. In short, that the *objection's* conclusion is unproblematic does not show that the *new circularity argument's* conclusion is unproblematic because they are different conclusions: they involve different contrasts.

Let's see how the new circularity argument's contrasts line up properly to generate the problematic conclusion. First I'll fill in the contrasts and then I'll review them:

4. D(=that a given flame burns yellow) helps to metaphysically explain the fact that it is a law that E(=that all sodium-salted flames burn yellow) *rather than* E's being an accidental truth while D is still true.

5. That it is a law that E *rather than* an accident helps to metaphysically explain E's having the power to scientifically explain D *rather than* E's being true but lacking that power while D is still true.

Therefore (by the transitivity of metaphysical explanation),

6. D helps to metaphysically explain E's having the power to scientifically explain D *rather than E's being true but lacking that power while D is still true (reductio)*.

In premise (5), a law E's being a law rather than an accident helps to metaphysically explain why E has the power to scientifically explain some Humean fact D (that a flame burns yellow) rather than E&D's being true but E's not having the power to scientifically explain D (i.e., rather than E's being an accidental truth and D's holding). In premise (4), that E is a law rather than an accident (the same contrast as in the explanans of the above premise) is partly metaphysically explained by the flame's burning yellow (since the flame's burning yellow contributes to E's strength and thus to its qualifications for membership in the BS). Since the same contrast (E's being a law rather than an accident) appears on the explanandum side of the metaphysical explanation in the argument's first premise (4) and on the explanans side of the metaphysical explanation in the argument's second premise (5), we can chain the two explanations together at their common point and conclude that D (that the flame burns yellow) helps to metaphysically explain why E has the power to scientifically explain D (rather than E's lacking that power but E&D's still being true). This is the viciously circular conclusion.

That the contrasts in the premises' metaphysical explanations line up is crucial to the new circularity argument's reaching its viciously circular conclusion. By attending to the alignment of these contrasts, we will be able to see that such a transitivity argument cannot be given too easily, but instead requires Humean presuppositions; if we do not presuppose Humeanism, then we cannot arrive at a conclusion involving such circularity. In particular, if we try to give a similar transitivity argument from premises that do not appeal to distinctively Humean presuppositions, then either the contrasts will not line up or, if they do, the argument will not reach the same problematic conclusion (i.e., a conclusion with the same contrast) as the new circularity argument reaches. Let's see an example.

One premise of the new circularity argument above is

5. That it is a law that E *rather than an accident* helps to metaphysically explain E's having the power to scientifically explain D *rather than E's being true but lacking that power while D is still true*.

Let's see what happens if we replace (4) with a premise that does *not* depend on Humeanism:

4*. D helps to ground E's truth, i.e., helps to metaphysically explain why E is true *rather than false*.

(For example, that this flame burns yellow (D) is part of one instance of the regularity E that all sodium-salted flames burn yellow and so helps to ground E.) We cannot chain these two metaphysical explanations (4*) and (5) together and thereby conclude (by the transitivity of metaphysical explanation) that

6. D helps to metaphysically explain why E has the power to scientifically explain D *rather than E's being true but lacking that power while D is still true.*

We cannot chain (4*) and (5) because they have different contrasts at their putative common point—namely, in the explanans of (5)'s metaphysical explanation and in the explanandum of (4*)'s. The contrast in (5) is “rather than E's being an accident” whereas the contrast in (4*) is “rather than E's being false.”

Suppose we try to avoid this problem by changing (5) to give it the right contrast to chain with (4*). We could replace (5) with

5*. That E is true *rather than false* helps to metaphysically explain why E has the power to scientifically explain D *rather than E's lacking that power by being false.*

Now by chaining (4*) and (5*), we arrive (by the transitivity of metaphysical explanation) at the following conclusion:

6*. D helps to metaphysically explain why E has the power to scientifically explain D *rather than E's lacking that power by being false.*

This conclusion is true and innocuous. But we cannot show in this way that the truth of the new circularity argument's conclusion (6) is innocuous, since the contrast in the explanandum in (6*)'s metaphysical explanation (“rather than E's lacking that power by being false”) is different from the contrast (“rather than E's being true but lacking that power”) in (6)'s metaphysical explanandum. The transitivity argument immediately above fails to reach the conclusion that the new circularity argument reaches.

None of these maneuvers is able to show that the new circularity argument's conclusion is unproblematic—that it can be reached without employing any distinctively Humean premises and so cannot be a *reductio* of Humean accounts of law.

4 More on contrasts

In (Lange, 2018:1349–52), I expanded my earlier (2013) critique by arguing that a circularity argument can be given even against those Humean accounts of law holding that the fact that E (all F's are G) is a law does not *itself* help to scientifically explain Ga, but instead helps to scientifically explain why Fa can scientifically explain Ga. Hicks (2021:547–51) replied that the contrasts in my (2018) transitivity argument fail to align. On Hicks's interpretation, my (2018) argument proceeds as follows. The first premise is that the fact that E is a law (rather than an accident) helps to scientifically explain why Fa has (rather than lacks) the power to scientifically explain why Ga (rather than \sim Ga) holds. The second premise is that the fact that Ga (rather than \sim Ga) holds helps (on the BSA) to metaphysically explain why E is a law (rather than false). By transitivity from these two premises, that Ga (rather than \sim Ga) holds helps to scientifically explain why E has (rather than lacks) the power to scientifically explain why Ga (rather than \sim Ga) holds, which is viciously

circular (or close enough). As we have already discussed, this argument chains together metaphysical and scientific explanation, but let's ignore this difficulty since my transitivity argument in the previous section does not suffer from it.

Hicks's point is that my (2018) transitivity argument above fails to go through because its contrasts fail to align. The explanans (that E is a law) in the *scientific* explanation (of Fa's power to scientifically explain why Ga) has as its contrast that E is an accidental truth. But the explanandum (that E is a law) in the *metaphysical* explanation has as its contrast that E is false. This misalignment, Hicks says, spoils the argument.³

Whatever may be the success of Hicks's objection to my (2018) circularity argument, the same objection cannot be made to my new circularity argument because that argument does not suffer from the same misalignment. Here again is the new circularity argument, with the relevant contrasts highlighted to show that they align:

4. D(=that a given flame burns yellow) helps to metaphysically explain the fact that it is a law that E(=that all sodium-salted flames burn yellow) *rather than E's being an accidental truth* while D is still true.

5. That it is a law that E *rather than an accident* helps to metaphysically explain E's having the power to scientifically explain D rather than E's being true but lacking that power while D is still true.

Therefore (by the transitivity of metaphysical explanation),

6. D helps to metaphysically explain E's having the power to scientifically explain D rather than E's being true but lacking that power while D is still true (*reductio*).

In premise (5), E's being a law rather than an accident helps to metaphysically explain why E is empowered to help scientifically explain why Ga (rather than \sim Ga—e.g., why the flame burns yellow rather than not) *rather than* E's not having that power, despite E&Ga's being true. In premise (4) (taken from the Humean account of law that is the target of this *reductio*), that E is a law rather than an accident (the same contrast as in the explanans in the previous premise) is partly metaphysically explained by Ga's holding (rather than \sim Ga—e.g., by the flame's burning yellow rather than not). So the contrasts align.

But they would not have aligned if (4) had been replaced by (4**): that E is a law *rather than false* is partly metaphysically explained by Ga. This substitute for (4) is presumably true (independently of Humeanism about law) since the flame's not burning yellow (while being sodium-salted) would make it false that all sodium-salted flames burn yellow. Nevertheless, the original premise (4) (that E is a law

³ Hicks says that the contrasts' failure to align explains why the argument leads from true premises to a false conclusion: that Ga (rather than \sim Ga) holds helps to explain why E has (rather than lacks) the power to explain why Fa scientifically explains Ga. Here is why the conclusion is false. The contrast in the conclusion's explanandum is that E lacks this explanatory power although Fa&Ga is true. But had this contrasting condition been true, it could not have been explained by \sim Ga (the contrast in the conclusion's explanans). So the conclusion cannot be a genuine explanation since when A rather than A' explains why B rather than B', it must be that if B' had been true, then it would have been explained by A'.

rather than an accident is partly metaphysically explained by Ga) is also true, on the BSA. The flame's burning yellow rather than not adds a yellow flame to the mosaic. It thereby increases the strength contributed by E's inclusion in a deductive system of truths. That is, the flame's burning yellow rather than not adds to the mosaic another yellow flame to be explained—to be covered by a law. In covering more of the mosaic's tiles, E brings more strength to any deductive system (that doesn't already have a means of covering those tiles).

On the Humean account, then, that the flame burns yellow rather than not helps E, even given its truth, to earn its way into the BS; it helps to make E a law *rather than an accident*. If the flame did not burn yellow but was still sodium-salted, E would be false. But the flame's burning yellow (and its being sodium-salted) also helps E (and any axiom in the BS needed to entail E) to pull its weight, i.e., to add enough strength to the BS to outweigh any loss of simplicity that its inclusion brings. Thus, Ga not only helps to make E true, but also helps to make E more of an asset to any candidate for BS.⁴

5 The ultimate Humean reply

I maintain that it is viciously circular for a fact in the mosaic to help metaphysically explain a law's power to scientifically explain that fact, even though this does not involve the fact's directly explaining itself. To defend the view that the circularity here is vicious, let's begin by following the argument for its viciousness that I gave in (Lange, 2018:1351–52). My strategy there was to compare this case to an analogous epistemic example. Black (1954) argued that we can justify induction by arguing that a given inductive rule had usually been successful (i.e., had led to the truth) in the past, so probably (by induction) it will be successful in its next applications. This inductive argument does not use *as a premise* the given rule's likelihood of future success. Hence, Black maintained, the argument avoids direct question-begging circularity. Nevertheless, Achinstein (1963) and Salmon (1967:13–17) are widely regarded as having convincingly argued that Black's approach is viciously circular because Black's argument depends on the given rule's future success by using it *as a rule of inference*.⁵

⁴ Of course, that a single particular flame burns yellow may not be (on the Humean account) a “difference-maker” regarding E's lawhood; there may well be sufficiently many other sodium-salted flames burning yellow that even in the absence of the particular flame with which D is concerned, E would still add enough strength to earn its way into the BS. (D's flame isn't special in this regard; perhaps no single particular sodium-salted flame burning yellow is a difference-maker.) Nevertheless, it remains the case that D (and each other particular flame) helps to make E strong enough to qualify for the BS. Premise (4) does not say that D alone suffices to metaphysically explain the fact that E is a law rather than an accident; premise (4) requires only that D *help to* metaphysically explain why E is a law rather than accidentally true. D (and each other particular flame) can do that even without being a difference-maker regarding E's lawhood.

⁵ The dialectical situation is more complicated than I have described since, as Salmon (1967:16–17) notes, Black recognizes that his “self-supporting” argument cannot address Hume's classic problem of induction. Black may well be correct that without depending on some other inductive argument (that could be called into question later, but is not being called into question now), no inductive argument can

In (Lange, 2018:1351–52), I argued that analogously, although no direct self-explanation would be involved in a mosaic fact’s metaphysically explaining a law’s power to scientifically explain that selfsame fact, a vicious circularity is still involved. A law is something like a rule of inference. For a fact to help metaphysically explain the explanatory power of a law that scientifically explains that fact is like the presupposition of an inference rule’s future success underwriting that rule’s power to legitimately mediate the inference to the rule’s future success. Both of these arrangements involve a circularity of *dependence*: the justification for believing an inference rule reliable cannot depend on that rule’s already being depended upon as reliable and, likewise, a law’s scientific explanatory power cannot metaphysically depend on a fact that itself depends upon the law.

This way of putting the argument invites the ultimate Humean reply to it. Yes, the Humean will say, the new circularity argument (unlike my original (2013) argument) successfully establishes its conclusion by transitivity because both of its premises consist of *metaphysical* explanations. But that conclusion (that a law derives its power to scientifically explain an event partly from that event itself) involves no vicious circularity. The appearance of vicious circularity comes from regarding both metaphysical and scientific explanation as relations of *dependence*. But scientific explanation, on the Humean unificationist picture, involves nothing like dependence; an event does not depend upon whatever law scientifically explains it. To see scientific explanation as involving dependence is to beg the question against the Humean by smuggling in a non-Humean commitment.

But now (it seems to me) the Humean is making the non-Humean’s case for her. Insofar as the Humean (under threat of vicious circularity) interprets scientific explanation as less and less like a kind of dependence, scientific “explanation” seems less and less explanatory. In talking about unification under the laws, the Humean is talking about an irreflexive and anti-symmetric relation to the BS without talking about a kind of explanation. In defending Humeanism about law, Duguid (2021:6048) embraces what I would construe as the powerlessness of Humean laws to explain mosaic events:

On the Humean view, laws are mere descriptions. ... Of course, they are not responsible for the mosaic; Humean laws are not responsible for anything! Ultimately, nothing is responsible for the mosaic being a certain way. It is a brute fact that the world is one with *this* pattern of events, as opposed to any other.

Duguid’s Humean sees no conflict between regarding mosaic events as scientifically explained by laws and regarding mosaic events as “brute”. But I would suggest that this view really amounts to regarding “scientific explanations” as not genuinely

Footnote 5 (continued)

be given a justification.

Hicks (2021:539–40) interprets laws precisely as I have just described (as rules of inference) in suggesting that a law does not itself explain a mosaic fact, but instead explains why one mosaic fact has the power to explain another.

explanatory at all and to taking only metaphysical explanations as explanatory. The Humean regards laws as able to “take responsibility” for a mosaic event only if laws are metaphysically more fundamental than the event, which (on the Humean’s view) they are not. So the Humean tries to give an account of scientific explanation where the explainer takes no responsibility for what it explains. But this seems like no explanation at all.⁶

For explainers to be “taking responsibility” for what they explain (and for the explanandum to “depend on” the explanans) seems like a neutral way to describe explanation. (Even Hicks (2021:534), despite his Humeanism, says that “explanations describe objective dependence relations.”) Without something recognizable pre-theoretically as responsibility being taken for the explanandum (and something recognizable pre-theoretically as dependence on the explanans), there is no explanation.

Humeans are in danger of thinning their notion of scientific explanation to such an extent that it is not pre-theoretically recognizable as constituting explanation. Of course, Bhogal (2020:175–76) and Duguid (2021:6041, 6051–52) try to motivate their picture of scientific explanation by citing the many philosophers and scientists who have described explanations as unifying. For instance, both Bhogal (2020:176) and Duguid (2021:6052) present the following passage from Hempel (1966:83) as identifying explanation with unification:

What scientific explanation, especially theoretical explanation, aims at is ... an objective kind of insight that is achieved by a systematic unification, by exhibiting the phenomena as manifestations of common underlying structures and processes that conform to specific, testable, basic principles.

However, this passage appears in Hempel’s chapter on “theoretical explanation”—the explanation of empirical *regularities*. Those are the sorts of explanations that Hempel especially has in mind here. By contrast, the circularity argument concerns

⁶ Of course, the Humean does not herself characterize Humeanism as taking “scientific explanations” to lack explanatory power. My point (in the rest of this section) is that the Humean has not succeeded in showing that “scientific explanations” under the Humean’s thin conception deserve to be regarded as possessing explanatory power.

Duguid (2021:6049) pursues exactly the Humean strategy that I have just described: “it is open to Humeans to rescue the explanatory role of laws by appealing to a ‘thinner’ form of explanation”, namely, where “scientific explanations that involve laws should be treated as cases of subsumption under a pattern.” Duguid aims to motivate this “thin” notion of explanation by arguing that explanations involving such subsumption are “commonplace”; Duguid gives examples such as “I sit at the back of the lecture theatre because all of the cool kids sit at the back of the class.” I applaud Duguid for aiming to give this sort of independent motivation for the thin notion of explanation. But Duguid’s examples seem to me to provide little motivation for the thin notion. Although the generalization that all the cool kids sit at the back of the class is appropriate to give in reply to the question “Why do you sit at the back of the lecture theatre?”, the generalization may not actually help to explain why I sit there. The generalization may merely *describe* the explanation without figuring in it: the reason why I sit there is the same as the reason why all of the other cool kids sit there. There is also another way for the generalization to gesture toward an explanation that does not work by subsuming the fact being explained under that generalization: I sit at the back because although I am not a cool kid myself, I want to appear cool and I know that all of the cool kids sit at the back.

the explanation of individual *events*. That is, it concerns the explanation of one of the particular facts in the Humean mosaic; the argument begins with a particular mosaic fact helping to metaphysically explain a regularity's lawhood, and it ends with a regularity's power to scientifically explain a particular mosaic fact. The passage from Hempel, then, does little to support the conception of explanation as unification to which Humeans appeal in their "ultimate reply" to the circularity argument. Humeans are taking the role of unification in the scientific explanation of empirical regularities and trying to use it to motivate their claim about the role of unification in the scientific explanation of individual events.⁷

Indeed, the most famous cases of unification that science has regarded as explanatory all involve much more than the subsumption of all of the phenomena being unified under a simple, strong deductive system—much more even than the discovery of laws that treat in the same way everything that is being unified. Hempel gives the examples of the explanation of Boyle's law by the kinetic-molecular theory of gases and the explanations of various optical phenomena by the wave theory of light; I would add Newton's unification of the force on falling bodies with the force keeping the planets in their orbits, for example, and Einstein's unification of space with time. All of these cases of explanatory unification involve ontological reduction: the identification of metaphysically more fundamental facts that are responsible for the facts being unified. For example, facts about spacetime were discovered to be responsible for facts about distances and time intervals in various reference frames. The Humean's thin notions of "scientific explanation", "unification", "dependence", and "responsibility" do not capture these cases of explanation by unification.

What I have been trying to suggest, then, is that Humeans cannot do much to motivate their thin notions of scientific explanation, unification, and the like by appealing either to famous historical cases of explanation involving unification or to the remarks of scientists and philosophers who have described explanations as unifying. The Humean's thin notions must find some other means of earning their credentials. Of course, if these thin notions are supposed to derive their *bona fides* not from scientific practice, but rather from their being thin enough to pass Humean muster, then a different, more immediate sort of damaging circularity threatens a Humean account of natural law: It is being used to support itself.⁸

⁷ Admittedly, the Hempel passage begins by announcing its subject to be scientific explanation generally. But the passage then immediately says that unification is "especially" central to theoretical explanation (the subject of Hempel's chapter). Furthermore, the passage characterizes the sort of unification relevant to explanation as involving "common structures and processes" that lie behind diverse empirical phenomena. These "common structures and processes" (the passage continues) all conform to "specific, testable, basic principles"—that is, to natural laws. Explanatory unification is thus achieved not by various empirical phenomena all falling under the same theoretical regularities that thereby become laws (as the Humeans portray that unification), but rather by various empirical phenomena all depending on the same theoretical structures and processes that are governed by independently-constituted laws. For these reasons (along with its focus on the explanation of a given empirical pattern rather than a given particular event), this passage does little to suggest the Humean conception of laws as explaining events by virtue of unifying them.

⁸ I have argued that it is viciously circular for a fact D in the mosaic to metaphysically explain another fact E's power to scientifically explain D. However, Hicks and Wilson (forthcoming: Sect. 4.2) seem to suggest that this arrangement is not viciously circular, but rather routine:

6 Conclusion

In this paper, I have proposed a new argument that scientific explanations by Humean laws involve a vicious circularity. Unlike previous charges of vicious circularity, my new argument employs no transitivity principle threading together metaphysical and scientific explanations. That is because all of the steps in this argument involve metaphysical explanations; it is uncontroversial that metaphysical explanation is transitive (when the contrasts line up). The explanatory contrasts in the steps of this new argument all align, avoiding another potential problem.

To this argument, a Humean could reply by accepting that its (seemingly viciously circular) conclusion follows from its (true) premises, but insisting that the conclusion involves no vicious circularity: An event can help to bestow upon a regularity the power to scientifically explain that selfsame event. But this would make the sort of “unification” created by Humean explanations so thin as to be difficult to recognize as explanatory in scientific practice. Of course, Humeans may nevertheless be willing to countenance this thin conception of explanatory unification,

Footnote 8 (continued)

“[I]t seems quite natural for facts about X to figure in explanations of what can explain X. In order to show that some Y explains that X, we will need to bring up features of both X and Y. To explain why your stepping on my tomato plant explains its stunted growth, I will need to point out features of its stunted growth – for example the fact that the branches that died are the ones you stepped on. Rather than being circular, this is straightforwardly good practice in higher-order explanation.”

(Thanks to a referee for suggesting that I address Hicks’s and Wilson’s remark).

To construe Hicks’s and Wilson’s remark as relevant to the purported vicious circularity that I have discussed, we must ensure that Hicks and Wilson are talking about how something is explained rather than *how we know* how something is explained. Hicks and Wilson say that “[i]n order to show that some Y explains that X, we will need to bring up features of both X and Y.” This remark seems to concern *how we know* that some Y explains X, whereas our topic is what *makes* Y explain X. (That the branches that died are the ones you stepped on is a good reason to believe that your stepping on the plant explains its stunted growth).

Furthermore, to construe Hicks’s and Wilson’s remark as relevant, we must bear in mind that the circularity argument is concerned with the way that a law explains a *fact* in the mosaic (recall note 1). Hicks and Wilson begin their remark by referring to “facts about X”, so X seems to be a particular (e.g., an event or object). But then Hicks and Wilson say that facts about X “feature in explanations of what can explain X”, as if X is now itself a fact being explained. Throughout the following example, I distinguish facts from what they are facts about.

Suppose that the fact that the rock possessed energy T at time t helps to explain why the window shattered. I agree with Hicks and Wilson that facts about the window’s shattering can help to explain why this energy fact about the rock can help to explain why the window shattered. For instance, the fact that the window came into contact with the rock at t helps to explain why the fact about the rock’s energy at t is explanatorily relevant to the fact that the window shattered (i.e., helps to explain why the energy-at-t fact is explanatorily relevant rather than the energy-at-t fact still holding and the fact that the window shattered still holding, but the former not being explanatorily relevant to the latter). But this contact-at-t fact, though a fact about the window (just like the fact that the window shattered), is not the fact about the window that is being explained by the energy-at-t fact (namely, that the window shattered). So we do not end up here with some fact X helping to explain why some other fact Y helps to explain X. Instead, we have one fact about the window helping to explain why Y helps to explain another fact about the window. Presumably, the fact that the window shattered does not help to explain why the energy-at-t fact helps to explain why the window shattered (rather than the energy-at-t fact still holding and the fact that the window shattered still holding, but the former not helping to explain the latter).

thereby rejecting the charge that the explanatory circularity is vicious. There is no knock-down argument in the vicinity against Humeanism. But the new argument that I have given at least exposes a new sort of explanatory circularity that Humeanism must acknowledge.

Funding There is no funding to acknowledge.

References

- Achinstein, P. (1963). Circularity and induction. *Analysis*, 23, 123–127.
- Armstrong, D. (1983). *What is a law of nature?* Cambridge University Press.
- Bhagal, H. (2020). Nomothetic explanation and Humeanism about laws of nature. In K. Bennett & D. Zimmerman (Eds.), *Oxford studies in metaphysics* (Vol. 12, pp. 164–202). Oxford University Press.
- Black, M. (1954). *Problems of analysis*. Cornell University Press.
- Correia, F. (2010). Grounding and truth-functions. *Logique et Analyse*, 52(11), 251–279.
- Correia, F., & Schnieder, B. (2012). *Metaphysical grounding: understanding the structure of reality*. Cambridge: Cambridge University Press.
- Dretske, F. (1977). Laws of nature. *Philosophy of Science*, 44, 248–268.
- Duguid, C. (2021). Lawful Humean explanations are not circular. *Synthese*, 199, 6039–6059.
- Fine, K. (2012). Guide to ground. In F. Correia & B. Schnieder (pp. 37–80).
- Hempel, C. G. (1966). *Philosophy of natural science*. Prentice Hall.
- Hicks, M. T., & Wilson, A. (forthcoming). How chance explains. *Noûs*.
- Hicks, M. T. (2021). Breaking the explanatory circle. *Philosophical Studies*, 178, 533–57.
- Hicks, M. T., & van Elswyk, P. (2015). Humean laws and circular explanation. *Philosophical Studies*, 172, 433–45.
- Lange, M. (1992). Armstrong and Dretske on the explanatory power of regularities. *Analysis*, 52, 154–159.
- Lange, M. (2013). Grounding, scientific explanation, and Humean laws. *Philosophical Studies*, 164, 255–261.
- Lange, M. (2018). Transitivity, self-explanation, and the explanatory circularity argument against Humean accounts of natural law. *Synthese*, 195, 1337–1353.
- Lewis, D. (1999). Humean supervenience debugged. In Lewis (Ed.), *Papers in Metaphysics and Epistemology* (pp. 224–247). Cambridge University Press.
- Lewis, D. (1973). *Counterfactuals*. Blackwell.
- Lewis, D. (1986). *Philosophical papers* (Vol. II). Oxford University Press.
- Loewer, B. (2012). Two accounts of laws and time. *Philosophical Studies*, 160, 115–137.
- Marshall, D. (2015). Humean laws and explanation. *Philosophical Studies*, 172, 3145–3165.
- Maudlin, T. (2007). *The metaphysics within physics*. Oxford University Press.
- Miller, E. (2015). Humean scientific explanation. *Philosophical Studies*, 172, 1311–1332.
- Raven, M. J. (2013). Is ground a strict partial order? *American Philosophical Quarterly*, 50(2), 191–199.
- Salmon, W. (1967). *The foundations of scientific inference*. University of Pittsburgh Press.
- Schaffer, J. (2012). Grounding, transitivity, and contrastivity. In F. Correia & B. Schnieder (pp. 122–138).
- Weinberg, S. (1992). *Dreams of a final theory*. Pantheon.

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

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.