

Necessities Overboard: A Reply to Lange*

Harjit Bhogal

Abstract

A classic objection to Humeanism about scientific laws is that Humeans cannot make sense of the *counterfactual invariance* of the laws. For example, if there were ‘nothing in the entire history of the universe except a single electron’ (Lange, 2009, p. 55) then, intuitively, the laws would still be the same. But classic Humean views don’t seem to get such results.

Some influential modern Humean views, particularly Dorst (2020), Loew & Jaag (2019), and Bhogal (2020), have argued that the Humean can, in fact, make sense of counterfactual invariance. Against this, Marc Lange (2022) has recently argued that modern Humean approaches are unsatisfactory. His conclusion that ‘this is the kind of evidence on which research programmes...should be judged’ (p. 27) suggests that he takes this to be (close to) a fatal problem for Humeanism.

In this discussion note I defend the Humean – in particular, the view of Bhogal (2020) – against Lange. The key idea is that the Humean should think of their reduction of the laws to the Humean mosaic as closely related to other views where we reduce one domain to another but still allow that the higher-level domain can be ‘autonomous’ of the lower-level in some respects – like, for example, the view that the special sciences reduce to physics but can still work autonomously of physics.

The ‘great divide’ in the metaphysics of science is between Humean and anti-Humean approaches to scientific modalities – most notably, scientific laws. Humeans take scientific laws to be reducible to the *Humean mosaic* of non-modal facts. Anti-Humeans disagree, holding a variety of positions where laws have more metaphysical heft. The debate is long and substantial, but it has been changing rapidly in recent years. Modern Humeans have developed novel responses to problems that have plagued Humeanism for years.

In particular, consider the classic objection that Humeans cannot make sense of the *counterfactual invariance* of the laws. The Humean seems to miscalculate claims about what laws

*Thanks to Callum Duguid, Siegfried Jaag, Marc Lange, Nick Laskowski and two anonymous reviewers for extremely helpful comments.

and counterfactuals would hold in nearby possible worlds. For example, if there were ‘nothing in the entire history of the universe except a single electron’ (Lange, 2009, p. 55) then, intuitively, the laws would still be the same.¹ But this appears to conflict with the Humean view – particularly, the standard reduction of the laws to the mosaic: the Best System Account (BSA) (Lewis (1983b, pp. 42-43), Lewis (1983a, pp. 365-368)). Roughly, the BSA says laws are simple and informative summaries of the mosaic of events. This seems to imply that Coulomb’s law, for example, does not hold in the one-electron world – that law is needlessly complicated for describing such a simple mosaic.

Similarly, consider the nested counterfactual ‘had there been nothing in the universe’s history but a single electron existing forever, then had there been more electrons existing forever, they would all have mutually repelled (as required by Coulomb’s law)’ (Lange, 2022, p. 5)². This seems true since, as we just noted, if there had been nothing in the universe’s history but a single electron existing forever then intuitively the actual laws would still have held. And the actual laws make it the case that had there been more electrons they would have mutually repelled. However, this appears to conflict with Humeanism. According to the BSA nothing like the laws of electromagnetism hold in the one-electron world, so there is no reason why electrons would repel each other (see, e.g. (Lange, 2009, p. 56), Hall (2010, section 5.4), Loew & Jaag (2019)).

Modern Humeans have developed versions of the view which, they claim, avoid these classic objections. Against this, Marc Lange (2022) has recently argued that modern Humean approaches are unsatisfactory. His conclusion that ‘this is the kind of evidence on which research programmes...should be judged’ (p. 27) suggests that he takes this to be (close to) a fatal problem for Humeanism.

In this discussion note I defend the Humean against Lange – arguing that this pessimistic conclusion is not warranted. In particular, I’ll defend my view, as developed in Bhogal (2020). But rebutting Lange is not the sole aim. Addressing Lange’s concerns will tell us a lot about how the Humean approach should be developed more generally. In particular, I suggest, the Humean should think of their reduction of the laws to the Humean mosaic as closely related to other views where we reduce one domain to another but still allow that the higher-level domain can be ‘autonomous’ of the lower-level in some respects – like, for example, the view that the special sciences reduce to physics but can still can work autonomously of physics.

¹See, e.g. Tooley (1977, p. 669), Carroll (1994, pp. 57-67) and Maudlin (2009) for similar cases.

²Page numbers for Lange (2022) are from the penultimate version, accessed here: <https://doi.org/10.1086/723621>

I LP and NP

Lange (2022) focuses on two principles about how laws are invariant under counterfactual suppositions.

NP If m is a law, p is logically consistent with all of the r 's taken together where it is a law that r , and q is likewise, then $p \Box \rightarrow (q \Box \rightarrow m)$. (p. 5)

(The lower-case letters here are restricted to 'sub-nomic' propositions. Roughly speaking, that means p , q , m , and r don't include terms like 'it is a law that...' and, more generally, don't include 'modal' terms – either those of metaphysical or natural modality. See (Lange, 2009, pp. 15-20) for further explanation.)

NP implies that had there been nothing in the universe's history but a single electron existing forever, then had there been more electrons existing forever, they would have acted in accordance with Coulomb's law and repelled each other.

LP If m is a law, n is not a law, and p is logically consistent with all of the r 's taken together where it is a law that r , then $p \Box \rightarrow (m \text{ is a law and } n \text{ is not a law})$. (p. 4)

(The same 'sub-nomic' restriction applies here.)

LP implies that had there been nothing in the universe's history but a single electron existing forever then Coulomb's law would still be a law.

As we noted in the last section, though, Humeanism appears to conflict with these implications of LP and NP.

The aim of Lange's paper is to criticize the Humean views of Dorst (2020), Loew & Jaag (2019), and my own view (Bhogal, 2020). Both Dorst and Loew and Jaag accept NP but not LP.³ Lange's main criticism of such views is one gestured at earlier: It's not clear why NP would hold if LP does not. If the counterfactual *had there been more electrons existing, they would all have mutually repelled* is true at a world then, presumably, that's because there is an associated law. Dorst and Loew and Jaag accept that this counterfactual is true in the one-electron world. But they deny that anything like the laws of electromagnetism hold at that world. Lange argues that this is an unstable position. There is much more to be said here, but on this point I broadly agree with Lange.

³As Lange notes (footnote 4), Dorst's doesn't explicitly commit to NP in his paper, but does in personal correspondence with Lange.

My view accepts both NP and LP.⁴The view is complicated – it purports to solve a variety of problems for the Humean – but we can roughly summarize how it captures NP and LP. Start from a distinction between scientific explanation⁵ and metaphysical explanation. The aim of scientific explanation, for the Humean, is unification – ‘assimilating specific events to more general patterns’ (Bhogal, 2020, p. 178). The aim of metaphysical explanation, on the other hand, is revealing the metaphysical dependence structure that is built into the world.

I, like many modern Humeans, understand Humeanism as a claim that the laws are *metaphysically explained* by the mosaic of non-modal facts.⁶ But, and here is the key move of Bhogal (2020), this metaphysical explanation doesn’t count as a scientific explanation because it goes against the aim of scientific explanation – 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 the 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. (Bhogal, 2020, p. 178)

The Humean metaphysical reduction of the laws to the mosaic cuts against the explanatory aims of science. Consequently, ‘the metaphysical explanation of the laws from the mosaic is not part of the scientific theory of the world’ (p. 184). This means that, in at least some contexts, it’s appropriate for scientists to ignore this reduction.

When we, in such scientific contexts, consider counterfactual suppositions like *had there been nothing in the universe’s history but a single electron existing forever* then the Humean reduction of the laws to the mosaic is not held fixed – it is ignored by that part of scientific practice. Rather, supposing *had there been nothing in the universe’s history but a single electron existing forever* takes us to a *metaphysically impossible* world – a one-electron world where Coulomb’s law still holds. This world is metaphysically impossible because in that world the Humean reduction of the laws to the mosaic does not hold.

More generally, in Bhogal (2020) I argue that the distinction between scientific and metaphysical explanation motivates an analogous distinction between scientific and metaphysical

⁴Actually, I don’t accept NP and LP in *full generality* (see section 3) and I suspect Dorst and Loew and Jaag don’t accept NP in full generality. What really matters is that all these authors evaluate counterfactuals that have traditionally been taken to be problematic for the Humean in line with these principles.

⁵More precisely, a kind of law-driven scientific explanation that I call *nomothetic explanation* in Bhogal (2020). Here I’ll carry on using the more familiar terminology of ‘scientific’ explanation.

⁶Both Lange’s and my talk of ‘reduction’ should be understood in this way – not as involving a commitment to any linguistic sense of reduction.

possibility where some worlds are scientifically possible – they are taken seriously by the practice of science and are relevant to the analysis of certain scientific modalities — but are not metaphysically possible. The one-electron world where Coulomb’s law holds is such a world. We can, at least in certain contexts, think of counterfactuals as analyzed in terms of this space of scientifically possible worlds, not the metaphysically possible worlds. Given this, standard criteria for judging which worlds are closest – valuing sameness of laws and of particular matters of fact (e.g. Lewis, 1979) – imply that the nearest one-electron world is one where Coulomb’s law still holds.

In the rest of the paper I’ll defend this view from Lange’s criticisms. Lange’s main worry, which comes out in a variety of ways in his paper, is that it is *ad hoc* for me to claim that the reduction of the laws to the mosaic is ‘ignored’ in some contexts. Lange raises some other concerns in passing – for example, whether scientific explanation can properly be understood as unificatory. I won’t discuss them in detail in order to keep the focus on the central cluster of issues.

2 Metaphysical necessities thrown overboard

Again, my view is that, in some contexts, the reduction of the laws to the mosaic is not held fixed under counterfactual antecedents like *had there been nothing in the universe’s history but a single electron existing forever*. This antecedent takes us to a one-electron world where Coulomb’s law still holds – the Humean reduction of the laws is ‘thrown overboard’. Lange worries this is *ad hoc*.

Do other metaphysical necessities besides the Humean reduction of lawhood get thrown overboard so easily under such counterfactual antecedents? Plausibly, the fundamental moral law (if there is one) is metaphysically necessary. Suppose that utilitarianism determines morally right actions. Do any counterfactual antecedents that are metaphysically possible (such as ‘Had Jones pulled the trigger...’) lead us to metaphysically impossible worlds where utilitarianism is violated? It seems not. Take another example: Plausibly, pure mathematical and logical facts are metaphysically necessary. Do any counterfactual antecedents that are metaphysically possible evoke metaphysically impossible worlds where pure mathematical and logical facts are not preserved? Again, it seems not. So carving out an exception for lawhood’s Humean reduction seems *ad hoc*. (p. 24)

Two initial points to be clear about as we consider this: Firstly, rebutting a claim that a particular argumentative strategy is *ad hoc* does not require defending the strategy against all objections. People can agree that the move is not *ad hoc* whilst still disagreeing with it on other, substantive grounds.

Secondly, as we saw in the last section, I do give a justification for lawhood's Humean reduction not being held fixed in counterfactual situations. So Lange's worry isn't that the move is *ad hoc* in the sense that no substantive justification is given. Rather, the concern is that it would be strange if the Humean reduction was not held fixed but other necessities were. This would cast doubt on the justification I give.

So, I'll respond by arguing that a very similar type of phenomenon arises with respect to a variety of reductive metaphysical views. Other necessities can, and do, get thrown overboard. My approach is not *ad hoc* but is in line with how we should think about reductive metaphysical accounts generally.

Start, as Lange does in the above quote, by considering an analogy with the moral realm. It's wrong to kill people for fun. What, then, should I do were I to prefer, even after reflection and study, to kill people for fun, and my society approves of killing people for fun? The answer is obvious: I still shouldn't kill. This is because the true first-order moral theory says that my preferences or society's approval aren't enough to make killing for fun ok. For example, maybe some form of consequentialism is true and my enjoyment from killing isn't enough to outweigh the badness to the victims. Or maybe the true theory comes with direct constraints ruling out such killing. Both of these views tell us that I shouldn't kill in such a situation.

The point of thinking about such non-actual situations, at least when we are doing first-order moral theorizing, is to reveal more about the moral nature of the actual world – to properly understand the actual moral facts and to help us make decisions about how to act, and how to react to others' actions, in the actual world. So, when we think about such non-actual situations, at least when we are doing first-order moral theorizing, we hold fixed the actual first-order moral theory.

This, I think, should be fairly uncontroversial. But further, imagine that the true metaethical theory is one where the actual moral facts are metaphysically determined by my preferences. Certain forms of constructivism or subjectivism are of this kind. Then, in some contexts, it will be right to say that if I were to prefer killing for fun then it's ok for me to kill. But, in the context of first-order theorizing – of thinking through our moral commitments and making decisions about what to do in the actual world – we should say what we did in the last two paragraphs. That is, even in the world where I approve of killing I should not kill. But this is for the antecedent *if I were to prefer killing for fun* to take us to a world where

the moral facts in that world do not depend upon my preferences. That is, we go to a world where the reduction of morality to preferences is thrown overboard. Or, at least, this is the moral analogue of the position I take about laws.

This type of idea is somewhat related to classic ‘rigidification’ defenses of subjectivism and other response-dependent metaethical views (see, for example, Dreier (1990)). Such moves stress that what fixes the moral facts are our actual attitudes. Even in the counterfactual world where I have a preference for killing, my actual attitudes against killing are what is relevant to the moral facts.⁷ But this means that in the counterfactual world where I have a preference for killing the moral facts don’t depend upon my attitudes in that world. There is a sense in which the true metaethical theory in that world is different from our world – moral facts don’t reduce to attitudes *in that world*.⁸

This is not to say that my strategy is one of rigidification – it’s not.⁹ But we can see how my approach might naturally apply in other domains – like that of morality. And we are already familiar with approaches to reductive metaphysical views where counterfactuals take us to worlds where, in at least one sense, the metaphysics is different – worlds where the reductionist claims that hold in our world do not hold.

Even more closely analogous to my approach is a view that comes up in defense of another class of reductive metaphysical theses – relationalism about quantities like mass, about motion, and about ‘handedness’ or chirality. Dasgupta (2020) argues, in a structurally similar way to Bhogal (2020), that there are two relevant types of possibility, connected to two distinct senses of explanation. And certain counterfactuals involve us ‘throwing overboard’ metaphysically necessary reductions – for example, the reduction of facts about mass to facts about mass relationships between objects (see, especially, sections 9-10). This allows the relationalist to avoid concerns about indeterminism (Baker, 2020).

It’s important to be clear about the force of these examples. It’s not that I expect Lange to be convinced by such views. It’s more likely, I suspect, that Lange will reject attitude-dependent

⁷Strictly, many such views say that what matters are *idealized* versions of our actual attitudes. But that complexity doesn’t matter for our purposes.

⁸Though, of course, moral facts in the counterfactual world do, on this picture, reduce to attitudes *in our world*. Thus my approach is not a rigidification strategy, even though it’s somewhat similar in spirit. The rigidifier will claim that in worlds where I have a preference for killing we hold fixed the metaphysical necessity that moral facts are determined by my actual (understood rigidly) attitudes. My approach, as applied to response-dependent metaethical views, says that the relevant metaphysical necessity is that moral facts are determined by our attitudes (understood non-rigidly) but that this necessity is, in some contexts, not held fixed when considering some non-actual worlds.

I think my approach has some significant advantages over the rigidification approach. Notably, rigidifiers don’t have a good answer to the question of why my attitudes in the actual world have the metaphysical power to generate moral facts but my attitudes in any other world does not. But that’s too much to get into right now.

⁹Notice that the simple application of the rigidification strategy to the case of laws – that laws in other worlds are fixed by the actual best system – leads to the bad result that the laws are the same no matter what the mosaic is like.

theories of morality and relationalism about mass. Rather, the point of these examples is to take the edge off concerns about *ad-hocness*. As we noted, I do give a justification, based on the difference between the aims of metaphysical and scientific explanation, for not preserving the Humean reduction of the laws to the mosaic in certain counterfactual settings. Lange's *ad hocness* concern is rather that I seem to 'carv[e] out an exception for lawhood's Humean reduction'. But these examples suggests that the spirit of my strategy isn't unique to Humeanism, but rather comes from a more general approach to reductive metaphysical accounts.¹⁰

But still, some will think that attitude-dependent theories of morality or relationalism about mass or motion are too controversial – or, some would say, implausible – to helpfully appeal to in this context, even just to fend off concerns about ad hocness. So it might help to discuss a more popular reductive thesis – the reduction of the special sciences to physics – and how this reduction is 'ignored' in certain counterfactual situations.

3 Special Sciences

It's common to think that facts about the special sciences are reduced to physical facts. However, there are contexts where this reduction gets ignored under relevant counterfactual suppositions.

For example, what happens in a world where information moves instantaneously and costlessly? Economists sometimes ask such questions and there are economic models about how the prices of assets would fluctuate in such a world. It's useful for economists to investigate such models because in seeing how the actual world differs from the outcomes of such models we can see the effect that lags in information can cause.¹¹ When we investigate these models in the context of doing economic theorizing, we don't care at all that such a world is physically impossible. We don't care that signals cannot move superluminally. We don't care that what constitutes the movement of information would have to be very different in this world from what it is in the actual world. And this is so even if we are physicalists and think that the economic facts hold in virtue of the physical facts.

¹⁰Further, see Nolan (1997, 2016) for additional reasons to doubt what he calls the *Strangeness of Impossibility Condition* – that any metaphysically impossible world is further from the actual world than any metaphysically possible world and consequently that any metaphysically necessity is held fixed under metaphysically possible suppositions.

¹¹For example, the commonly discussed idea that stock prices are a random walk derives from the assumption of instantaneous and costless information transfer. 'The logic of the random walk idea is that if the flow of information is unimpeded and information is immediately reflected in stock prices, then tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today' (Malkiel, 2003, p. 59). The ways in which stock prices deviate from this ideal has been much discussed in the past few decades of financial economics.

Further, notice that when we are considering such economic counterfactuals we don't assume that the economic facts are reduced to the physics in some other way. We don't, for example, reason that if information moved instantaneously and costlessly then General Relativity is false and our technologies, like GPS, which rely on relativistic considerations would be inaccurate, leading to significant changes in the stock prices of various companies. When we consider, in at least some contexts, what would happen if information moved instantaneously and costlessly we think about the economic consequences of this without dropping back down, so to speak, and reasoning about the physical level.

This is a way in which methodology in economics can be *autonomous* of the physics. When considering what would happen in certain economic situations we ignore the reduction of economics to the physics and just look at what our economic principles tell us.

More generally, when domain X is reduced to a domain Y the range of possibilities associated with X can still outstrip those associated with Y. That's because when we are reasoning with the higher-level domain X we can consider higher-level objects and how they can interact in accordance with higher-level principles, without worrying about how such possibilities would look reflected back down to the lower-level domain.¹²

I claim, in effect, that the Humean reduction of scientific laws is like this. Laws are reduced to the mosaic, but, in certain contexts, we ignore this reduction. When we reason about the possibilities consistent with Coulomb's law, for example, we don't worry about the consequences that the reduction of the laws has for the lower-level.

Once we see this analogy with the special sciences then, I think, many of Lange's criticisms become somewhat less forceful. For example, in Bhogal (2020) I discuss a very simple world with the same laws as our world but where there are only two objects, one much bigger than the other, in order to model how objects fall to earth. Comparing this simple world to the actual world is useful for seeing the role that air resistance plays in our world. However, this world is, for the Humean, metaphysically impossible – in such a simple world the Humean reduction of laws would not result in the laws being the same as our world. Lange worries that:

But then failure to leave fixed what property constitutes lawhood (as on Bhogal's account) seems like it would spoil the comparison even more. That is, it would make the comparison even less able to isolate the impact of air resistance.

¹²Here another, perhaps helpful, way to think about this point. It's familiar that in some contexts when considering a counterfactual antecedent *p* we are disinclined to 'backtrack' and reason that the facts causally prior to *p* would have been different. The cases we have been considering suggest that, analogously, we are sometimes disinclined to 'downtrack'. That is, in some contexts when we are considering some counterfactual antecedent *q* about some higher-level domain, we are disinclined to reason that the facts *metaphysically* prior to *q* would have been different. Clearly, though, this gets at much larger issues about counterfactuals than we can fully get into here.

The usefulness of the comparison, Lange claims, is undermined by the fact that whatever constitutes lawhood in this simple world would have to be different from what constitutes it in the actual world. But it is still useful to compare the world with instantaneous and costless information transfer to the actual world, even though in the hypothetical world movement of information would have to be constituted differently. In both cases we can usefully reason about the higher-level domain, comparing it to the actual world, while ignoring the actual reduction of those higher-level facts.

Further, Lange complains that:

Bhogal's account involves...ugliness in positing a metaphysically necessary Humean reduction while arranging that this reduction make no difference to an important part of scientific practice.

Various worries in this spirit run through Lange's paper. But again, it should be somewhat familiar to us that facts of one domain can hold in virtue of another while the practice of the higher-level domain is largely autonomous of the lower-level. Of course, there are hard questions about the nature of such autonomy and the precise nature of the reductions involved in the special sciences, for example. But merely recognizing such autonomy doesn't make for an *ad hoc-ness* or ugliness in the reductionist's theory.

So far in this section we have been considering counterfactuals with the antecedent *if information moves instantaneously and costlessly*, noting that in some contexts when we evaluate such counterfactuals we ignore the reduction of economics to the physics. Notice that one salient feature of the example is that the antecedent is, on its own, inconsistent with the physical laws. But this isn't a necessary feature of any such case.¹³ For example, imagine talking to an economist who is thinking about the business model of a casino, and you ask what would happen if someone played the slot machine 100 million times in a row.

It's physically possible that the machine was played so many times but, it seems, the machine would degrade leading to the probabilities of the relevant outcomes changing. So, one reasonable response to your question is that if the machine was played so many times it would break down.

But, given the context, where we are thinking about the economics of casinos, another natural response is to tell you about the expected return of the casino, based on the current probabilities that the machine outputs prizes – *if someone were to play the slot machine 100 million times in a row then the casino would make, on average, \$28,361,121*. The relevant counterfactual world here is one where the slot machine does not degrade and the physical probabilities

¹³The rest of this section is inspired by sections 4 and 5 of Holguín & Teitel (n.d.).

do not change over the 100 million plays. But the physical laws would have to be different in the counterfactual world where slot machines are so resilient.¹⁴

Notice that there could be pervasive, but nomically possible, thermodynamic miracles that lead to the machine not degrading. Call such a thermodynamically miraculous world where the laws are the same as the actual world w_1 . However, the antecedent *if someone were to play the slot machine 100 million times in a row* does not take us to w_1 , because that world is so extremely unlikely. Our normal practices of evaluating counterfactual antecedents do not take us to worlds where there are such pervasive thermodynamic miracles.

If we hold fixed the physical laws when evaluating what would happen if someone were to play the slot machine 100 million times in a row then the nearest worlds are ones where the machine would degrade. Consequently, in the contexts where we are inclined to assert *if someone were to play the slot machine 100 million times in a row then the casino would make, on average, \$28,361,121* it must be that we are not holding the physical laws fixed. (See Holguín & Teitel (n.d., section 4.2.1) further making this case with respect to somewhat different examples.)

However, when we evaluate this counterfactual we don't imagine that other physical laws hold and try to draw out the consequences of them for the economics of casinos – would those laws make the costs of powering the slot machines higher? Rather we simply ignore the reduction of the economics to the physics.¹⁵

Lange's strategy in response to this case will be to deny counterfactuals like 'if you were to play the slot machine 100 million times in a row you would lose, on average, \$28,361,121' are true. Rather, when the economist says the above sentence they are really expressing a subtly different counterfactual like 'if, *by magic*, you were to play the slot machine 100 million times

¹⁴In response to puzzles about the interaction of counterfactuals and determinism – given determinism if, contrary to fact, X had happened then, it seems, either the whole history of the world or the laws would have to have been different – Lange (2000) accepts that laws can be false. 'Actual laws can be violated in a possible world and still remain laws there, as long as every violation occurs "offstage," outside the range of events with which we are concerned in contemplating this world.' (p. 76) This move doesn't help Lange here since the violations of the laws happen 'onstage' – in the process of the slot machine being played so many times.

¹⁵A possible response: Perhaps in the context of talking about the economics of casinos the extreme unlikelihood of world w_1 isn't a reason to think that it is distant from the actual world. Perhaps, in this context, we can tolerate incredibly unlikely, pervasive, thermodynamic miracles. So, the antecedent *if someone were to play the slot machine 100 million times in a row* doesn't take us to a world where the laws are different.

This is an interesting suggestion. However, even if true it still illustrates my larger point about how we, when evaluating such counterfactuals, ignore the reduction of the economics to the physics.

Even if the antecedent *if someone were to play the slot machine 100 million times* in this context takes us to a world with lots of thermodynamic miracles we don't, when we evaluate this counterfactual, think about the consequences of these thermodynamic miracles for the economic questions under consideration. We don't, for example, reason that such thermodynamic miracles inside the machine would involve materials within the machine acting in wildly unexpected ways and so would affect the probabilities of the machine outputting certain prizes – thus changing the return on playing the machine so many times. Rather we just ignore the reduction of the economic probabilities to the physics. (Thanks to a referee for discussion of this point.)

in a row you would lose, on average, \$28,361,121' which is plausibly true (Lange (2000, chapter 2, section 2.1), Lange (2009, chapter 1, note 29), Holguín & Teitel (n.d., section 5.1)).¹⁶

However, notice that there doesn't seem to be much independent motivation for this reading of the counterfactual. The motivation is to save Lange's specific views about the connection between counterfactuals and modality. I don't say this to criticize Lange's view but rather to point out that the natural reading of 'if you were to play the slot machine 100 million times in a row you would lose, on average, \$28,361,121' tells in favor of the type of view I defend. Even if there are possible moves Lange can make to get such sentences to align with his broader theory those moves don't recover the idea that my approach is *ad hoc*.

4 The Modal and the Postmodal

That's the main response to Lange. A variety of reductive metaphysical accounts are best developed by allowing that, in some contexts and for some purposes, the reduction is ignored. The higher-level domain has autonomy – it can float free of the lower level. This undercuts the concern that allowing the Humean reduction of lawhood to be ignored is *ad hoc*. I'll end by discussing one other criticism that Lange mentions, since, I think, it gets at the deepest disagreement between Lange and myself, as well as many other modern Humeans.

Lange complains that:

Bhagal's account does not seem to treat metaphysical necessity with the respect it is due. Necessity has long been understood as a kind of inevitability, unavailability, 'that which will be whatever supposition we make with regard to other things' (Mill [1874], book 3, chap. 5, sect. 6). Moreover, metaphysical necessity is supposed to be one of the strongest varieties of necessity. (pp. 23-4)

According to Lange, my view disrespects metaphysical necessity by allowing that antecedents like *Had there been nothing but a single electron* can take us to metaphysically impossible worlds.

I suspect this issue, about giving metaphysical necessity its appropriate respect, is the deepest source of disagreement between Lange and myself. In Bhagal (2020) I embrace this disrespect of metaphysical necessity:

¹⁶In personal correspondence Lange agreed that this would be his strategy.

Perhaps you might worry that...metaphysical possibility becomes, in some sense, devalued; it no longer plays as central a role as it used to. I think there is some truth in this, but I don't think it's a bad result. (p. 190, fn 24)

Following that passage I endorse a 'postmodal' approach to metaphysics. An approach characterized by deemphasizing modal issues and claiming that the central metaphysical issues are about actual world relations – for example, relations of metaphysical explanation. This postmodal approach is naturally combined with a somewhat deflationary approach to metaphysical possibility – where metaphysical necessity is not a deep part of the world, but a mere symptom of underlying metaphysical structure. (see, for example, Schaffer (2009, p. 364), Kim (1993, p. 167), Wilsch (2017, section 3)).¹⁷

For example, a postmodal theorist might naturally accept a kind of conventionalism about metaphysical modality, in the spirit of Sider (2011) and Cameron (2009, 2010). On this approach we can understand metaphysical possibility in terms of consistency with the metaphysical facts and it is conventional which facts we class as 'metaphysical' – though, as a matter of fact, we typically include facts about grounding or metaphysical dependence structure in this class. We have a distinction, then, between metaphysically possible and impossible worlds but 'there is nothing ontologically special about this distinction as opposed to the myriad other distinctions that we could have latched on to (Cameron, 2009, p. 15)'. If the distinction between possible and impossible worlds is deflated in this way then it's much less concerning that some counterfactuals can take us from metaphysically possible antecedents to metaphysically impossible worlds.

Alternatively, and this is closer to the view of Bhogal (2020), a postmodal theorist might think that modality is to be understood in terms of explanation. Possibilities, you might think, consist in 'reorganizing fundamental matters' (Dasgupta, 2020, p. 137). And something is fundamental if it is unexplained. This suggests that if there are multiple types of explanation then there are multiple types of modality. Metaphysical possibility comes from reorganizations of the metaphysically unexplained; scientific possibility comes from reorganizations of the scientifically unexplained; moral possibility comes from reorganizations of the morally unexplained; economic possibility comes from reorganizations of the economically unexplained. Dasgupta (especially section 7) defends an approach in this spirit. On this approach there isn't some single 'absolute' necessity – modality is just a symptom of explanatory structure. As Dasgupta notes 'This approach will be rejected by those seduced by

¹⁷Lange says that: 'But by contrast with physical necessity, metaphysical necessity (on Bhogal's account) does indeed reflect "a deep part of the world"' (p.23). But I don't commit to this. A more natural reading of Bhogal (2020) (see especially section 2.1) is that metaphysical dependence structure is a deep part of the world, not metaphysical necessity.)

the idea that there is a clear, univocal notion of “metaphysical possibility” that we grasp independently of its connection to fundamentality and explanation.’ But he takes there to be ‘no content to talk of metaphysical possibility apart from its connection to explanation’ (p. 149).

These postmodal approaches differ greatly from Lange’s picture of the world as deeply modally infused. Lange takes there to be primitive counterfactuals. And the set of counterfactuals is structured so that they can be used to define up the difference between genuine and non-genuine modalities (see Lange (2018, section 1) for an elegant summary of his vast and detailed work on this). Not giving metaphysical necessity its due respect runs contrary to this picture of modality. Some of Lange’s criticisms, it seems, stem from this deep difference in modal metaphysics.

Of course, this is not an argument that Lange is wrong about modality. We are not going to resolve that here. But it is a diagnosis of some of Lange’s concerns. It’s a way to understand why Lange views some of my moves as *ad hoc*, but also to see that my moves are natural against the background of a different picture of modality. My response to worries about counterfactual invariance of the laws involve decentralizing metaphysical modality – in particular, thinking that metaphysical modality isn’t always the right tool in representing our discourse and thought in scientific practice. If we already think of metaphysical modality as more deflated or less central to our theorizing then such an approach is not *ad hoc*.

Lange’s criticisms and the responses given here help us see what commitments the Humean has to take on if they are to avoid their problems with counterfactual invariance. This won’t cause Lange, and likely other committed anti-Humeans, to convert to Humeanism – how often does that happen? But that’s not the standard for success in a substantial and long-lasting debate like that between Humeans and anti-Humeans. Hopefully, though, we have made progress in isolating the deepest disagreements between the sides and, perhaps, even the committed anti-Humean might see why certain Humean moves make sense in the context of plausible theoretical background assumptions.

References

- BAKER, D J. 2020. Some Consequences of Physics for the Comparative Metaphysics of Quantity. *Oxford Studies in Metaphysics Volume 12*, 12, 75.
- BHOGAL, HARJIT. 2020. Nomothetic Explanation and Humeanism About Laws of Nature. *Pages 164–202 of: BENNETT, KAREN, & ZIMMERMAN, DEAN W (eds), Oxford Studies in Metaphysics, volume 12*. Oxford University Press.

- CAMERON, ROSS. 2010. On the Source of Necessity. *In: HALE, BOB, & HOFFMANN, AVIV* (eds), *Modality: Metaphysics, Logic and Epistemology*. Oxford University Press.
- CAMERON, ROSS P. 2009. What's Metaphysical about Metaphysical Necessity? *Philosophy and phenomenological research*, **79**(1), 1–16.
- CARROLL, JOHN. 1994. *Laws of Nature*. Cambridge University Press.
- DASGUPTA, SHAMIK. 2020. How to Be a Relationalist. *Pages 113–163 of: Oxford Studies in Metaphysics Volume 12*. Oxford University Press.
- DORST, CHRIS. 2020. Why do the Laws Support Counterfactuals? *Erkenntnis. An International Journal of Analytic Philosophy*, 1–22.
- DREIER, JAMES. 1990. Internalism and Speaker Relativism. *Ethics*, **101**(1), 6–26.
- HALL, NED. 2010 (Jan.). *Humean Reductionism About Laws of Nature*.
- HOLGUÍN, BEN, & TEITEL, TREVOR. *On the Plurality of Counterfactuals*.
- KIM, JAEGWON. 1993. *Supervenience and Mind*. Supervenience and Mind. Cambridge: Cambridge University Press.
- LANGE, MARC. 2000. *Natural Laws in Scientific Practice*. Oxford University Press.
- LANGE, MARC. 2009. *Laws and Lawmakers: Science, Metaphysics, and the Laws of Nature*. Oxford University Press.
- LANGE, MARC. 2018. What Would Normative Necessity Be? *The journal of philosophy*, **115**(4), 169–186.
- LANGE, MARC. 2022. Can Pragmatic Humeanism Account for the Counterfactual Invariance of Natural Laws? *The British journal for the philosophy of science*, Dec.
- LEWIS, DAVID. 1979. Counterfactual Dependence and Time's Arrow. *Nous*, **13**(4), 455–476.
- LEWIS, DAVID. 1983a. New work for a theory of universals. *Australasian Journal of Philosophy*, **61**(4), 343–377.
- LEWIS, DAVID. 1983b. *Philosophical Papers, Volume 1*. Philosophical Papers, Volume 1. Oxford: Oxford University Press.
- LOEW, CHRISTIAN, & JAAG, SIEGFRIED. 2019. Humean Laws and (Nested) Counterfactuals. *The Philosophical quarterly*, **70**(278), 93–113.

- MALKIEL, BURTON G. 2003. The Efficient Market Hypothesis and Its Critics. *The journal of economic perspectives: a journal of the American Economic Association*, **17**(1), 59–82.
- MAUDLIN, TIM. 2009. *The Metaphysics Within Physics*. The Metaphysics Within Physics. New York: Oxford University Press.
- NOLAN, DANIEL. 1997. Impossible worlds: A modest approach. *Notre Dame Journal of Formal Logic*, **38**(4), 535–572.
- NOLAN, DANIEL. 2016. Conditionals and curry. *Philosophical studies*, **173**(10), 2629–2647.
- SCHAFFER, JONATHAN. 2009. On What Grounds What. In: MANLEY, DAVID, CHALMERS, DAVID J, & WASSERMAN, RYAN (eds), *Metametaphysics: New Essays on the Foundations of Ontology*. OUP.
- SIDER, THEODORE. 2011. *Writing the Book of the World*. Oxford University Press.
- TOOLEY, MICHAEL. 1977. The Nature of Laws. *Canadian journal of philosophy*, **7**(4), 667–698.
- WILSCH, TOBIAS. 2017. Sophisticated Modal Primitivism. *Philosophical Issues. A Supplement to Nous*, **27**(1), 428–448.