In Defense of Humean Non-Universal Laws[1]

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Abstract: In this paper, I raise a novel objection to David Lewis's Humean account of laws. The objection is that non-universal laws are metaphysically possible, but Lewis's account cannot accommodate them. I then propose and defend an extension of Lewis's view that gives us an account of Humean non-universal laws.

Humeanism about laws is the view that the laws of nature are descriptive generalizations about the particular facts.[2] The laws are not fundamental entities or necessary connections, such as on an anti-Humean view.[3] A prominent Humean view of laws is David Lewis's best systems analysis (BSA) of lawhood (see Lewis 1973a; 1983; 1986b; 1994). In this paper, I raise a novel objection to Lewis's view relating to *non-universal laws*, laws that do not universally hold in a world. I argue that Lewis's view cannot adequately accommodate the possibility of non-universal laws. The upshot is that we need a new Humean account of laws, and I propose and defend an extension of Lewis's account that allows for non-universal laws.

In §1, I explain Lewis's view of laws, counterfactuals, and causation. Next, in §2, I describe a thought experiment relating to non-universal laws which shows that Lewis's

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[2] Many Humeans about laws (e.g., Lewis (1994) and Weatherson (2015)) hold another view, called "Humean supervenience". Humean supervenience is the view that the world is a mosaic of spacetime points and all qualitative truths about the world supervene on facts about which perfectly natural properties are instantiated at spacetime points and facts about spatiotemporal relations between points. But this view is not to be confused with Humeanism about laws; not all Humeans need endorse Humean supervenience. For example, David Lewis (1994) endorsed it as a contingent thesis. In this paper, I will assume Humean supervenience. This is not a substantial assumption but made out of convenience. Humeans who reject Humean supervenience can substitute talk of spacetime points in what follows with talk of whatever it is they believe the perfectly natural properties and relations are instantiated at and between respectively, as well as add talk of perfectly natural relations that are not spatiotemporal when needed.

[3] Examples of anti-Humean philosophers who endorse the view that the laws of nature are fundamental nomological entities are John Carroll (2004) and Tim Maudlin (2007). Examples of anti-Humean philosophers who endorse the view that the laws of nature are necessary connections between universals are Fred Dretske (1977), Michael Tooley (1977), and David Armstrong (1983).

framework cannot accommodate them. Then, in §3 and §4, I propose and defend an extension to Lewis's framework that gives us an account of Humean non-universal laws. Finally, in §5, I explain the consequences of this account on Humean theories of counterfactuals and causation.

Before moving on, I need to clarify the scope of this paper. The goal of this paper is to defend a Humean account of non-universal laws, but not to defend a Humean account of laws in general. In other words, my goal is to argue that *if* you are a Humean, you can accommodate the possibility of non-universal laws. Humeanism about laws is a controversial view, and many objections have been raised against it.[4] But I will set aside objections to Humeanism about laws in general, because defending the broader view lies beyond the scope of this paper.

§1 Humeanism about Laws, Counterfactuals, and Causation

On Lewis's best systems account of laws, we start with a long list of facts about perfectly natural properties instantiated at spacetime points and about spatiotemporal relations between points. Then, we build deductive systems that are consistent with this long list of facts. Some systems are simpler (or better systematized) than others, and some systems are stronger (or more informative about the world) than others. We choose the best system, which best balances simplicity and strength, and give the following analysis of laws.

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[4] See Hall (2015) and Bhogal (2020a) for helpful overviews of such challenges. Here are a *few* prominent challenges and responses. Some object to Humeanism because Humean laws supervene on the non-nomic facts and some see this as objectionable (see, e.g., Tooley (1977: 660-672), Carroll (1990: 202-204; 1994), Menzies (1993: 199-200), Bird (2005: 355), Maudlin (2007: 16, 67)). Humeans respond by arguing that the anti-Humean alternative is untenable (see, e.g., Lewis (1983: 366) and Loewer (1996: 196)), denying the relevant intuitions (see, e.g., Loewer (1996), Roberts (1998), Beebee (2000), and Earman and Roberts (2005)), or distinguishing different kinds of possibility (see, e.g., Bhogal (2020b)). Some object to Humeanism by arguing that Humean laws cannot be inductively confirmed (see, e.g., Carnap (1962: 570-571), Dretske (1977: 258), Tooley (1977: 693), and Strawson (1989: 24)), but Humeans have responded by appealing to Bayesian epistemology (see, e.g., Loewer (1996: 190)) or by arguing that this challenge begs the question (see, e.g., Hall (2015: 31)). Some object to Humeanism on the grounds that it leads to explanatory circularity (see, e.g., Maudlin (2007: 182), and Emery (2019)), but Humeans respond by distinguishing different kinds of explanation (see, e.g., Loewer (2012; 2019) and Bhogal (2020b)). In this paper, I assume Humeanism, so my goal is not to defend Humeanism against any of these objections. (Thank you to an anonymous referee for raising this issue.)

Law Analysis: *l* is a law of a world *w* if and only if *l* is entailed by the best system of *w*. (Lewis 1973a, 73).

In the discussion to follow, I will assess various accounts of laws by evaluating the consequences of the accounts on facts about counterfactuals and causation. (These are not the only sorts of facts that laws have consequences for, but in this paper, I will focus on these.) In this paper, I will rely on Lewis's analysis of counterfactuals and causation to explain these consequences.[5] So, I need to explain Lewis's accounts of counterfactual and causal facts, and how the laws play a role in determining these facts. First, here is Lewis's (1973b; 1979) account of counterfactuals.

Counterfactual Analysis: "If it were the case that *p*, then it would be the case that *q*" is true in a world *w* just in case some world in which *p* and *q* are true is closer to *w* than any world in which *p* is true but *q* is false.

Closeness of worlds is determined by how similar two worlds are to each other. The similarity metric to determine closeness between possible worlds will vary considerably due to various factors like conversational context. However, in most cases, we use the ordinary, default metric which Lewis (1979: 464) calls the "standard resolution".

(1) It is of the first importance to avoid big, widespread, diverse violations of law.

[5] Whether Lewis's analyses of counterfactuals and causation are successful is of course controversial, and numerous objections have been raised to them. (See, e.g., Bennett (1974), Fine (1975), Tichý (1976: 271), Bowie (1979), Sanford (1989: 173), Tooley (2003), Kment (2006), and Wasserman (2006) for objections to Lewis's account of counterfactuals. See, e.g., Ehring (1987), Elga (2000), and Paul and Hall (2000: Chap. 5), Hall (2004) for objections to Lewis's theory of causation.) But I will assume and rely on Lewis's accounts because they are prominent Humean accounts and further, because the objections to Lewis's accounts do not matter for the purposes of this paper since they will not affect the points made. All that matters for our purposes is that on all prominent Humean accounts of laws, the laws of nature play a central role in determining counterfactual and causal facts. (Thank you to an anonymous referee for raising this issue.)

(2) It is of the second importance to maximize the spatiotemporal region throughout which perfect match of particular fact prevails.

(3) It is of the third importance to avoid even small, localized, simple violations of law.

(4) It is of little or no importance to secure approximate similarity of particular fact, even in matters that concern us greatly. (ibid.: 472)

For example, "if Pelé had not kicked the ball, then it would not have flown" is true at the actual world since a world in which Pelé doesn't kick the ball and it doesn't fly is closer to the actual world than any world in which he doesn't kick the ball but it still flies. We get this result by examining the laws and facts of the actual world and other possible worlds. Therefore, in most contexts, laws play a crucial role in determining counterfactuals.

Finally, here is a Lewisian account of causation. For our purposes, the following naïve counterfactual analysis of causation will do, since it will not affect the points made.[6]

> *(Naïve) Causation Analysis*: If *A* and *B* are distinct events that occurred, "*A* causes *B*" is true just in case if *A* had not happened, then *B* would not have happened (ibid.: 161).

For example, Pelé's kicking the ball *caused* it to fly since, as we just saw, if he had not kicked the ball, it would not have flown. Again, since the laws of nature (usually) play a role in determining counterfactuals, which in turn play a role in determining facts about causation, the laws of nature (usually) play a role in determining facts about causation.

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[6] For example, Lewis defends a very roughly similar theory in "Causation" (1973c). His views evolved over time, and he defended a more sophisticated account in "Causation as Influence" (2000). But counterfactuals play a crucial role in both theories. That is all that is required for the purposes of this paper.

§2 Non-Universal Laws

§2.1 What are Non-Universal Laws?

By "universal laws", I mean laws that hold at all spacetime points of a world, and by "non-universal laws", I mean laws that do not. In other words, and more roughly, universal laws hold at all times and places, but non-universal laws might just hold of certain times (for example, a world in which certain laws hold for the first 100 billion years, but not afterward), of certain places (for example, a world in which certain laws hold in one galaxy, but not others), or of certain times and places (for example, a world in which certain laws hold just on a single planet for a century, but not elsewhere or elsewhen).

That the laws of nature cannot vary from one spatiotemporal region to another may seem conceptually or obviously true. But the possibility of non-universal laws *has* been discussed (see Poincaré 1911; Whitehead 1933; Armstrong 1983; Balashov 1992; Shimony 1999; Lange 2008; Beebee 2011; Takho 2015; Sartenaer, Guay, and Humphreys 2020). Also, Michael Tooley (1977) hints at the possibility while discussing his famous Smith's Garden case, a garden where all fruits are apples, seemingly by a law of nature. Further, Tim Maudlin (2007: 12) and Misner, Thorne, and Wheeler (1973: 1214) have argued that our current theories of physics suggest that the actual world might be one with non-universal laws, let alone some possible world. I take this as evidence that non-universal laws are compatible with our current understanding of physics and metaphysics, and so cannot be ruled out *a priori*.

§2.2 A Thought Experiment

In this subsection, I raise an objection to Lewis's account by way of a thought experiment relating to non-universal laws. The upshot is that non-universal laws are possible, but Lewis's account cannot accommodate them and therefore needs to be extended.

First, consider a possible world w*. This world consists of a very large number of particles moving around in the world. Further, suppose that this world is in total pandemonium. The particles pop in and out of existence, accelerate and change directions of their own accord, and spontaneously transform into elephants. As a result of this, there are no laws in this world. To be more specific, on Lewis's BSA, there are no laws, since there is no system that is simple and strong enough to capture the positions and relative velocities of the particles of w*. Any function that successfully does so is too complicated to be in the best system.

Second, consider a set Ω of possible worlds, such that each world in the set has different laws of nature. Suppose further that this set is very large – in fact, it contains exactly as many worlds as there are particles in w*. Ω contains the actual world, $w_{@}$, which has robust laws of nature, such as the Einstein field equations (EFE). It also contains a Newtonian world, w_N in which, for example, all bodies with mass act in accordance with $f = ma$. It even contains w*, the world from above that is completely lawless. Now, consider a possible world, Giganto Jr.,[7] that contains non-overlapping duplicates of every possible world in Ω.[8] Suppose that all the duplicates are separated by great distances, say trillions of light years.[9]

Third, and finally, consider another possible world Humongo, Giganto Jr.'s wacky cousin. This world is, roughly speaking, a combination of w* and Giganto Jr. It is just like

[7] Giganto Jr. is named after the larger Giganto (Nolan 1996: 242), a world that contains a duplicate of *every* possible world. Nolan discusses Lewis's (1986a: 102) and Forrest and Armstrong's (1984) argument that there is no such metaphysically possible world.

[8] To me, the existence of this possible world seems intuitively metaphysically possible. But it also straightforwardly follows from plausible metaphysical principles of plenitude. First, there is David Lewis's (1986a: 89) Principle of Recombination, which roughly allows us to recombine objects freely, and then there is Phillip Bricker's (1991: 617) Plenitude of Structures, which roughly allows for any logically (or mathematically) possible structure to be metaphysically possible. These two principles guarantee Giganto Jr.'s existence.

[9] If the actual world is infinite, then Giganto Jr. may need another dimension. In what follows, it will be convenient for me to assume that twin-$w_{@}$ is finite. In light of these two points, if the actual world is in fact infinite, let "$w_{@}$" refer to a duplicate of a large, but finite portion of the actual world. Further, let it be assumed, unless I say explicitly otherwise, that the other worlds I discuss here are finite.

Giganto Jr., in that it consists of duplicates of possible worlds in Ω. However, the duplicates of possible worlds are *moving*, and they are moving in *exactly* the same way as the particles of w*.[10] More specifically, there is an isomorphism between the positions and relative velocities of particles in w* and the positions and relative velocities of duplicates of possible worlds in Humongo.[11] It's important to note that although the duplicates of the worlds as a whole don't have all the same properties that the particles do – such as their mass, charge, and so on – their positions and relative velocities are the same.

Here is the crucial point. When we "zoom out" of the world, the structure of the world looks very similar to that of w*, and more specifically, it is just as complex. As a result, if there is no simple function that captures the movement of particles in w*, there *must* be no simple function that captures the movement of duplicates of worlds in Humongo. So, there is no simple function that captures the movement of all the *particles* within the duplicates of the worlds. Therefore, there are no laws of motion in Humongo on Lewis's BSA.[12]

But I claim, there are. Humongo begins to look very different from w* when we "zoom in" on the world. Let's examine the duplicate of $w_@$, called "twin-$w_@$" for short. Twin-$w_@$ is a duplicate of our world $w_@$, so when we restrict our attention to twin-$w_@$, it looks just like ours. It even contains a planet very much like ours, called "twin-Earth". As a result of this, the same

[10] Again, this world seems intuitively metaphysically possible to me, but it also follows from the principles of plenitude discussed in Footnote 7.

[11] Since the particles in w* are not infinitely large and do not exist for infinite lengths of time, in order for there to be such an isomorphism, the duplicates of the worlds in Ω need to be finite and of appropriate size. So, we simply need to assume that Giganto Jr. and Humongo contain duplicates of *finite (appropriately sized) portions* of the worlds in Ω.

[12] We also cannot limit the scope of the laws of the worlds in Ω to describe the motions of the particles in Humongo, because these laws no longer correctly describe the motion of the particles in Humongo. Here is an illustration. Consider a world *w* in Ω such that the motion of its particles can be described by a simple function *f*. The duplicate of *w* in Humongo, twin-*w*, is moving in a very complicated way relative to the other duplicates. So, *f* does not correctly describe the motion of the particles of twin-*w*, so "all particles in twin-*w* act in accordance with *f*" cannot be a law because it is not true. As a hint to my solution later in the paper, we need some way to systematically ignore the rest of Humongo when describing the laws of twin-*w*.

regularities about perfectly natural properties that hold in $w_@$ also hold in twin-$w_@$. For example, in twin-$w_@$, all bodies of mass obey the Einstein field equations (EFE). For the region of Humongo occupied by twin-$w_@$, it really seems as if the same laws of nature of our world apply.

Let's now examine the duplicate of the Newtonian world, w_N, which we will call twin-w_N for short. Just like with $w_@$ and twin-$w_@$, w_N and twin-w_N are very similar. As before, the same regularities about perfectly natural properties that hold in w_N also hold in twin-w_N, such as $f = ma$. Again, it seems that the laws of twin-w_N are the same as those of w_N. Finally, twin-w^* is quite different. Just like w*, there are no robust regularities that hold of the perfectly natural properties. It seems that there are no laws that hold of the portion of Humongo that is twin-w*.

It seems obvious to me that the correct takeaway from this thought experiment is that different laws hold in different parts of Humongo. That is, while there are no laws that hold in Humongo *universally*, there are robust *non-universal laws* that hold when we restrict our attention to portions of Humongo. For example, it seems the EFE are *laws* in twin-$w_@$. If we were in twin-$w_@$, we would use the EFE to make predictions about future events and to explain past events in twin-$w_@$. We would use the EFE to determine counterfactuals as well as causal facts in twin-$w_@$. If we were in twin-$w_@$, we wouldn't even be aware of the chaos happening in the rest of the world. Crucially, however, this would not hold if we were in twin-w_N. In that case, we would instead use *Newtonian laws*, like $f = ma$ to make predictions and explain events, and similarly to determine counterfactuals and causal facts in twin-w_N.

Now, we saw that according to Lewis's BSA, there are no laws that hold of Humongo. But what this discussion has shown is that this is clearly the wrong result – as I argued above, Humongo does have laws, just non-universal ones. This alone is a good reason to reject Lewis's original BSA, in search for another Humean view that allows for non-universal laws.

But the problems are even worse. Since there are no laws in Humongo, we get the wrong facts about counterfactuals and causation using Lewis's analyses. Suppose in twin-$w_{@}$, twin-Pelé kicks a ball that then flies. Since there are no laws that hold in Humongo, Lewis would have to insist that the following counterfactual is true: "if twin-Pelé had *not* kicked the ball, it *still* would have flown". This is because a possible world in which twin-Pelé does not kick the ball, but it still flies is closer to Humongo than any world in which twin-Pelé does not kick the ball and it does *not* fly. *This* is because all of these worlds have no laws of motion, but the former possible world above differs less in terms of particular *fact* from Humongo than any of the latter possible worlds above.[13]

So, we get absurd counterfactual facts in Humongo on Lewis's analyses. As a result of this, we also get the wrong facts about causation. We have to say that twin-Pelé did not cause the ball to fly, when clearly, he did. In short, a Humean who only accepts universal laws, such as ones that result from Lewis's analysis, cannot understand Humongo in a way that is remotely close to our intuitive understanding of laws, counterfactuals, and causation.

So, Lewis's analysis gets the wrong results for the case of Humongo. But the point of this discussion is not just to show that Lewis's analysis fails in very obscure cases. There are all sorts of worlds that intuitively have non-universal laws that are not as complex as Humongo. Consider simpler worlds like Giganto Jr. – which consisted of many stationary duplicates of possible worlds with different laws – or even Giganto III – which is a world that contains just *two* non-overlapping duplicates of possible worlds with different laws. These worlds are not as complicated, and therefore not as difficult to systematize, as Humongo. *Perhaps* there are simple

[13] See Wasserman (2005: 592) for a similar example which inspired this discussion.

and strong enough systems that capture the facts of these worlds, so *perhaps* there are laws in these worlds on the BSA.

But the BSA will always get the wrong result about *what* the laws are in these worlds, because it requires that we systematize the *entire* world, instead of just portions of it. For example, in Ω, there is a possible world that contains just a single stationary ball of iron, and nothing else. The laws of this world are very simple, and similarly, the *non-universal laws* of the duplicate of this world in Giganto Jr. should be very simple as well. But Giganto Jr. contains a *huge* number of duplicates of possible worlds, and so, *if* there is a best system of this world, it will be *enormously* complex. As a result, the laws around this ball of iron will be enormously complex, when they shouldn't be. Similarly, in the duplicate of our world in Giganto Jr., there are scientists explaining regularities, making predictions, and evaluating counterfactuals. Do they need to use an enormously complex system to do so? On Lewis's account, they would.

The point is that, on Lewis's view, *whether* there are laws in small, organized regions of a world is hostage to the complexity of the entire world, as the example of Humongo indicated. But even further, on Lewis's view, *what* the laws are in small, organized regions of a world is *also* hostage to the complexity of the entire world, as the examples of Giganto Jr. and Giganto III indicated. Instead, I claim, regions of local regularity should be able to have robust facts about laws, counterfactuals, and causation *regardless* of what the rest of the world is like. Therefore, we need a new Humean analysis of non-universal laws.

§3 Humean Non-Universal Laws

How would a Humean analyze non-universal laws? Humean laws are universal *generalizations*, not *entities* that can be present in one part of a world but absent in another. So, it may seem that a world in which a generalization like "All Fs are Gs" is not universally true is simply a world in which “All Fs are Gs” is not a law of nature on any Humean view. As David Armstrong (1983: 23) writes, “…it does seem clear that the [Humean] Regularity theorist is in a weak position to resist the suggestion that there can be...spatio-temporally limited laws.”

I don’t think this need be the case. In the next two sections, I will argue that Humeans *can* accommodate non-universal laws. I will proceed in two steps. In §3, I consider an account of non-universal laws, but argue that it is not adequate. However, doing so will be dialectically useful for two reasons. First, in developing this account, I introduce conceptual ideology that will be necessary in the final proposal that I defend. Second, by going through objections to the view, I make clear exactly *why* the proposal fails. This will help us identify the objections we need to avoid in building a new view. Then, in §4, I propose and defend a new account of Humean non-universal laws.

§3.1 The Proposal

Let’s start by fixing some terminology. If there are non-universal laws of a world, they need not hold of the entire world but of *regions* within that world.[14] What is a region of a world? As I have been assuming, the world consists of a mosaic of spacetime points.[15] So, here is a definition.

> *Definition*: Consider a world *w*, and let the set of spacetime points of *w* be *S*. Then, a *region* of *w* consists of the spacetime points of a nonempty subset of *S*.

[14] As Sartenaer, Guay, and Humphreys (2020: 20-21) note, in order for any kind of theory about non-universal laws of nature in a Humean view to get off the ground, the world needs to possess some kind of primitive topological structure that allows us to “chop up” a world into distinct regions. However, I don’t think that assuming there is such structure is a cost to the account. If the world does not possess such structure, then it would not make sense to talk about a region of a world or about the non-universal laws of a world. In other words, it wouldn’t make sense to talk about different laws holding *here* and *there*, if the world doesn’t have enough structure to distinguish *here* and *there*.
[15] Again, this is not a substantial assumption. (See Footnote 1.)

Note, that on this definition, a region of a world can be the entire world itself. Additionally, note that regions are spatiotemporal. For example, the first 100 billion years of a world, a particular galaxy, and a certain planet only in the 16^{th} century are all regions of a world.

Given this understanding of regions, the suggestion for Humean non-universal laws is as follows. We can think of regions of a world as "tiny possible worlds". That is, first, we consider a subset of the spacetime points of a world, composing a region. Then, we build a list of facts of perfectly natural properties instantiated at those spacetime points and facts about spatiotemporal relations in between those points. We then build deductive systems consistent with *these* facts which compete based on balancing simplicity and strength. Now, here is a proposal for Humean non-universal laws:

> *Non-Universal Law Analysis*: *l* is a law *relative to a region R* if and only if *l* is entailed by the best system *of R*.

Let's try applying this proposal. Consider again Humongo, the possible world that contains, among other duplicates, twin-$w_@$, twin-w_N, and twin-w*, which are duplicates of the actual world, a Newtonian world w_N, and a lawless world respectively. To determine the laws relative to each of these regions, we systematize *all and only* the spacetime points that belong to these regions. So, the laws of nature relative to twin-$w_@$ are the same as the laws of our world. This is because these laws are the theorems of the best system consistent with the fundamental facts of the region of the world that is twin-$w_@$. This system includes a theorem like "all objects act in accordance with the EFE", so this is a law that holds relative to twin-$w_@$. Similarly, the laws of twin-w_N are the laws of w_N, since these laws are the theorems of the best system consistent with the fundamental facts of the region of the world that is twin-w_N. This system includes "all objects act in accordance with $f = ma$", so this is a law relative to twin-w_N. On the other hand, there are no laws of nature relative to twin-w*. This is because there is no best system consistent with the fundamental facts of the region of the world that is twin-w*. Finally, and for a similar reason, there are no laws of nature relative to Humongo, because the *entire* world is too complex to be organized into a best system. This allows us to retain the intuitive idea that twin-$w_@$ and twin-w_N are organized regions with robust laws while both Giganto Jr. and twin-w* are not.

So, an advantage of this proposal is that it allows us to systematize small, organized regions within a complex world like Humongo, without worrying about the complexity of the entire world. We can make claims about the laws of twin-w_N or twin-$w_@$ by systematizing the facts of these individual regions, but we don't need to use an enormously complex system as we would to systematize the world as a whole.

Given this analysis of Humean non-universal laws in which laws hold relative to all sorts of regions, what should we say about counterfactuals and causation? We can apply the analysis of non-universal laws *relative to each region* to get an analysis of counterfactuals and causal facts that hold *relative to that region*. To do this, we must calculate closeness of *regions* to other possible *regions* (of possible worlds), again as if the regions themselves are tiny possible worlds. Of course, as before, closeness will vary depending on the context. However, we can say that in most ordinary contexts, the default procedure for evaluating the closeness of possible regions uses Lewis's standard resolution for evaluating closeness of worlds discussed in §1, in which we consider similarity of facts and laws.

Then, the proposal for evaluating relativized counterfactuals is the following:

> *Relativized Counterfactual Analysis*: "If it were the case that *p*, then it would be the case that *q*" is true *relative to a region R* if and only if some region in which *p* and *q* are true is closer to *R* than any region in which *p* is true but *q* is false.

To give an example, the counterfactual "*relative to twin-*$w_{@}$, if twin-Pelé had not kicked the ball, then it would not have flown," comes out true, since twin-$w_{@}$ is closer to a possible region in which twin-Pelé does not kick the ball and it does not fly than it is to any possible region in which twin-Pelé does not kick the ball but it *still* flies. We get this result by examining the *non-universal* laws and the facts of twin-$w_{@}$, and the laws and facts of these other possible regions belonging to other possible worlds.

Similarly, we can use the relativized counterfactual analysis to give a relativized (naïve) analysis of causal claims. That is,

> *Relativized Causation Analysis*: When *A* and *B* are distinct events that occurred, "*A* causes *B*" is true *relative to* a region *R* just in case *relative to R*, if *A* had not happened, then *B* would not have happened.

For example, r*elative to twin-*$w_{@}$, twin-Pelé caused the ball to go through the posts, since as we saw above, *relative to twin-*$w_{@}$, if twin-Pelé had not kicked the ball, then it would not have gone through the posts. These seem like the right results, because in chaotic worlds with local regions of regularity, we will get robust facts about counterfactuals and causation, *relative to these regions*. In summary, we have an account of Humean, non-universal laws, as well as an analysis of counterfactuals and causation, embedded within this account.

§3.2 Problems

So, we have a simple account of Humean non-universal laws. However, this proposal will not do. In this subsection, I highlight the problems for the account, which we need to address in the final account. These problems stem from the fact that there were no constraints in our definition of "region". Recall that according to the definition, *any* collection of spacetime points of a world forms a region which has its own laws. A region can be a collection of spacetime points close together, or a collection of scattered spacetime points, or one with holes in it, or overlapping with other regions, and so on. Let me emphasize all of these features in detail.

First, a region need not be *connected*[16] (not composed of separated parts). To see why this consequence is problematic, note that many generalizations will be laws for *some* region. For example, in the actual world, take all the objects that have a mass of two grams, scattered throughout our world.[17] Call the region that contains all and only spacetime points at which these two-gram objects are located "*R*". Then, *relative to R*, it seems it is a law that all objects have a mass of two grams. But this seems like the wrong result. Surely, it's not a law of our world, in *any* sense, that all objects have a mass of two grams. Further, because of this, absurd counterfactual and causal facts follow. For example, relative to *R*, if I had moved my hand two inches to the right (into *R*), it would have weighed two grams. But again, it doesn't seem as if this counterfactual should be true in any sense.

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[16] For a more precise definition, let's start with topological definitions. See Rudin (1976: 42). "Two subsets A and B of a metric space *X* are said to be *separated* if both $A \cap \bar{B}$ and $\bar{A} \cap B$ are empty [where "$\bar{A}$" denotes the closure of A], i.e., if no point of A lies in the closure of B and no point of B lies in the closure of A. A set $E \subseteq X$ is said to be connected if E is *not* a union of two nonempty separated sets." Roughly, the idea is that a connected set is one which is "completely whole", without parts that are far away from each other. Adapting these set-theoretic definitions to regions, we can then say two *regions* R and S are separated if and only if, where the set of spacetime points of R and S are R' and S' respectively, both $R' \cap \bar{S'}$ and $\bar{R'} \cap S$ are empty. Then, a *region* R is connected if and only if the set of spacetime points of R is not the union of two nonempty separated sets of spacetime points.

[17] Thank you to Phillip Bricker for raising this example.

Second, and worse, a region need not be *generally connected*[18] (connected and without holes). For example, suppose there is a world in which many x-particles collide, sometimes acquiring spin-up and sometimes acquiring spin-down. On this view, we can "poke holes" in the world to ignore all the instances of x-particles acquire spin-up, so relative to the region with holes, it's a law that all x-particles acquire spin-down when they collide. This is again a problematic consequence. Intuitively, if there are widespread violations of a regularity throughout a world, that regularity is not a law in that world, in *any* sense. Further, we get that, relative to this region, if two particular x-particles had collided, they definitively would have acquired spin-down. Again, it seems this counterfactual should not be true in any sense, because some x-particles acquire spin-up and some acquire spin-down.

Finally, and worst of all, regions of a world need not be *disjoint*[19] (nonoverlapping). That is, an event can take place in two overlapping regions with different laws. For example, in Humongo, the event of twin-Pelé kicking the soccer ball takes place in the region twin-$w_{@}$ *and* the region Humongo, relative to each of which there are different, incompatible laws. So, it follows on the account that at the *same* spacetime point (within the event), relative to one region, it's a law that all large bodies obey the EFE, while relative to another region, it's not. Although this does not lead to a contradiction, since each statement about the laws has a relativization

[18] Again, we can formulate a more precise definition by adapting the definition from topology. See Björner, Matoušek, and Ziegler (2017: 78). "Let $k \geq -1$. A topological space X is *k-connected* if [and only if] for every $l = -1, 0, 1, \ldots, k$, each continuous map $f: S^l \to X$ can be extended to a continuous map $\bar{f}: B^{l+1} \to X$. (Equivalently, each $f: S^l \to X$ is nullhomotopic.)" In other words, and more roughly, to be *k-connected* is to have no holes of *k* or less dimensions. Now, let a region *R* be *generally connected* if and only if *R* has *k* dimensions and *R* is k-connected. The notion of general connectedness which I am defining here is just a convenient shorthand to refer to a region without holes, so that I don't have to keep referring to the number of dimensions of the region in question. Note that on this definition, all generally connected regions are connected.

[19] We can say two *regions R* and *S* are disjoint or nonoverlapping if and only if the sets containing the spacetime points of *R* and *S* are disjoint. See Enderton (1977: 3). "Sets *A* and *B* are said to be *disjoint* when they have no common members, i.e., when $A \cap B = \emptyset$."

operator attached to it, this feature is especially problematic.[20] Shouldn't we be able to say, at a particular point, what the laws are, *simpliciter*? There may be infinitely many regions that a particular point is a part of, so there may be infinitely many different answers to the question, depending on which region we select. Further, again as a result of this, counterfactuals become indeterminate and relative. For example, what would have happened if twin-Pelé had not kicked the ball? *Relative to twin-*$w_@$, the ball would not have flown, but *relative to Humongo*, it would have, but there is no determinate fact of the matter about what would have happened *simpliciter*, nor about whether twin-Pelé caused the ball to fly *simpliciter*. Again, although this does not lead to a contradiction, this kind of relativity is untenable.[21]

As a result, with plausible assumptions, facts about personal identity and perception also become unacceptably relative on this account. On many popular views, facts about personal identity (see e.g., Lewis 1976; Shoemaker 1984) and perception (see, e.g., Grice & White, 1961) are determined by facts about causation. If facts about causation are relative, then there is simply no determinate fact of the matter about whether I existed two minutes ago, nor about whether I am perceiving a tree right now. This is untenable.[22]

In short, because of the way we defined "region", non-universal laws need not hold of regions that are connected, generally connected, or even disjoint, and this has absurd

[20] However, it may be contradictory on a view like Maudlin's, since on such an anti-Humean view, laws are primitive nomological *entities* (Maudlin 2007: 18), not just patterns or ways of describing patterns as on a Humean view.
[21] Again, this may be contradictory on an anti-Humean view in which there are, for example, metaphysically fundamental causal powers or metaphysically fundamental counterfactual structure in a world.
[22] Note that I am not merely rehashing familiar objections to Humeanism, à la Hawthorne (2004), Wasserman (2005), or Shumener (2021). It is well-known that Humeanism makes certain facts, like facts about laws, personal identity, and consciousness, extrinsic. Humeans may have to live with this consequence. But a Humean *need* not live with the consequence that such facts are relative and indeterminate. This is much more radical.

consequences for counterfactual and causal facts. In other words, we need more constraints on the sorts of regions laws can hold of.

§4 Humean Absolute Non-Universal Laws

This discussion helped us identify two main issues an account of Humean non-universal laws must address. First, the account must avoid radical relativity. On the previous account, different laws, and therefore different counterfactual and causal facts, could hold in the same region. Second, the account must add substantial constraints on what regions laws can hold of. On the previous account, laws could hold of regions that are scattered, that have holes, or that are separated by a great distance.

In this section, I propose and defend an alternative Humean account that avoids these issues. I address each issue in turn. To preview, first, in §4.1 and §4.2, I introduce the notion of *absolute*, as opposed to relative, laws, counterfactuals, and causation. I also introduce the notion of a *privileged region* and make use of it with the notion of relativized laws from the previous account. Together, these notions address the problems for the account relating to relativity. Second, in §4.3, I discuss a series of proposals of constraints on what sorts of regions can be privileged. This addresses the problems I raised for the account relating to how regions could have holes, be separated, and so on.

§4.1 Absolute Laws

So far, we have been trying to develop an account of non-universal laws, in contrast to universal laws. As I explained, universal laws are laws that hold at every spacetime point in the world, while non-universal laws need not. Let me now make another distinction between *absolute* laws and *relative* laws. By "absolute law", I mean a law that holds *simpliciter* without a relativization operator, and by "relative law", I mean a law of nature that holds only *relative* to a region. An example of an absolute law is "all bodies obey the EFE", while an example of a relative law is "*relative to twin-*$w_{@}$, all bodies obey the EFE". Since relative laws contain relativization operators, it is not contradictory to assert that at the same spacetime point, the following both hold: "relative to region *R*, it is a law that *p*" but "relative to region *R-and-S*, it is not a law that p". However, since absolute laws hold without such operators, it would be contradictory to assert the following hold at the same spacetime point: "it is a law that *p*" and "it is not a law that *p*". In other words, while multiple incompatible *relative* laws can hold of the same spacetime point, multiple incompatible *absolute* laws cannot hold of the same spacetime point.

Now, let's combine these concepts. The previous account was an account of *relativized*, non-universal laws. It was non-universal in the sense that different laws could hold at different spacetime points (such as the different laws relative to twin-$w_{@}$ and twin-w*), but it was relative in the sense that different laws could hold at the *same* spacetime point (such as the different laws relative to twin-$w_{@}$ and Humongo). We will now try to develop an account of *absolute, non-universal* laws. On the new account, laws need not hold universally in a world, but at the *same spacetime point*, the laws will hold absolutely or *simpliciter*. Because of the way we gave an analysis of relativized, non-universal laws on the previous account, to say that relative to *R-and-S*, it is a law that *p* is to say nothing about whether it is also the case that relative to *R*, it is a law that *p*. But because of the way that we will give an analysis of absolute, non-universal laws on the new account, to say that *at R-and-S*, it is a law that *p* is also to say that at *R*, it is a law that *p*. This will purge our account of the relativity that plagued it.

§4.2 The New Proposal

So, we desire an account of non-universal, but *absolute* laws. We want to be able to say what the laws are at twin-Earth or twin-w*, and potentially give different answers to each, but *at* one of these regions, we want to give an absolute, non-relative answer. As we saw in the previous section, however, each of these regions is contained in potentially infinitely many overlapping regions. The region twin-Earth is contained in twin-$w_{@}$, Humongo, and so on, relative to each of which, there are different laws. So, given that we only want *one* answer to the question of what the laws are on twin-Earth, which of these regions should we pick?

Here is what I suggest. Among these infinitely many overlapping regions that contain twin-Earth, we will say *one* of these regions is *privileged*. This region will be *privileged* in the sense that despite there being multiple regions relative to which different laws hold at twin-Earth, the laws that *absolutely* hold at twin-Earth will be the laws *relative to* this privileged region. In other words, although we rejected the previous relativized account of laws, we will rely on the notion of relativized laws to give the new account. This will still yield us *absolute* laws for twin-Earth because we will say only the laws of the privileged region will hold *simpliciter* for any spacetime point within twin-Earth. The task of specifying *how* to determine which region is privileged will be the focus of §4.3, but for now, I will let the notion of a privileged region be a placeholder. Given this, here is a proposal for Humean absolute non-universal laws.

> *Absolute Non-Universal Law Analysis*: *l* is an *absolute* law of a region *R* if and only if *l* is a law relative to the privileged region that contains *R*.

Here is how the analysis works. Suppose we ask what the laws are on twin-Earth. We determine the privileged region that contains twin-Earth, which as we will see in §4.3 turns out to be twin-$w_{@}$. Then, we examine the laws *relative* to twin-$w_{@}$. The laws that hold of twin-Earth *simpliciter* will be the laws *relative* to twin-$w_{@}$.

§4.3 The Privileged Region

Now, given a region, what is its privileged region? In this subsection, I go through a series of suggestions on how to pick the privileged region. These suggestions will also specify constraints on what sorts of regions can be privileged regions, to avoid the issues of laws holding of regions that have holes, are scattered, and so on. To argue for this final proposal, I slowly build up the proposal, component by component, by considering a series of steps toward the final proposal. Doing so will serve as an argument for the final proposal – it will make clear why each component of the final proposal is included and what counterexamples it avoids.

Here is a suggestion to start. The rough idea is that the privileged region should be generally connected (connected without holes) to avoid the issues we saw in the previous section. Further, the privileged should be as large as possible, so that there is a difference in the absolute laws whenever we see different regularities in the world... but only when there is such a difference. More precisely,

> *Largest Region*: Given a region *R* of a world, choose the largest[23] generally connected region of the world that contains *R* and that has the same relativized laws as *R*.

Here is how *Largest Region* works. Suppose we ask, back on Humongo – what are the laws at twin-Earth? To answer this, we input "twin-Earth" into *Largest Region*, which requires us to

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[23] We saw above that we need to assume worlds have topological structure that allows us to chop up the world into regions. Now, we also need to assume that the worlds have a metrical structure (see, e.g., Maudlin 2012: 7) which will allow us to measure the length of trajectories in spacetime. We can then use these lengths to calculate the size of a region of spacetime. A precise theory of *how* exactly to calculate the size of a region and compare it with other regions, especially infinite regions, is of course beyond the scope of this paper. My point here is just that such structure is needed. But as before, I don't think assuming that there is such structure is a cost to the account, since the very concept of non-universal laws requires that the worlds in question have such structure. Without it, for example, we would not be able to distinguish a world in which on one side, all particles have spin-up, and on the other side, all particles have spin-down from a world in which particles with spin-up and spin-down are both scattered throughout the world. We need to be able to say that in the former world, all the particles with spin-up and spin-down are *close* to each other respectively, but not so in the latter world.

select the largest generally connected region that contains twin-Earth, *and* such that the laws relative to this region are the same as the laws relative to twin-Earth. It seems this privileged region would be twin-$w_@$. Then, the absolute law analysis from above tells us that the laws *simpliciter* at twin-Earth are the laws relative to twin-$w_@$, robust laws like the EFE. This seems like the right result – at twin-Earth there are robust laws that hold absolutely, not relatively.

Despite initially seeming plausible, *Largest Region* does not work. Roughly, the problem is that we can "zoom in too far". Consider a world that only contains a large number of x-particles. Suppose that whenever two x-particles collide, they explode. This is the only regularity in this world, so it seems it is a law of this world. Let's "zoom in" on the world, examining two x-particles, x_1 and x_2. At one point in time, x_1 and x_2 come very close to colliding but fly past each other. Now, consider a generally connected region of this world that contains only x_1 and x_2. Call this region "*P*". Since *P* only contains particles that do not collide, the laws for *P* will not include "whenever two x-particles collide, they explode". Including it in a deductive system of the facts of *P* would make that system much less simple, but no stronger, so it would not appear in the *best* system of the facts of *P*. So, the *privileged* region of P, which by *Largest Region* is required to have the same laws as those of P, will not include "whenever two x-particles collide, they explode" either. In other words, we get the result that it is *not* an absolute law at *P* that whenever two x-particles collide, they explode. This is the wrong result – clearly, it is a law at *P*, and we would use this law to evaluate counterfactuals and causal facts.

In light of this, here is another suggestion. Roughly, the idea is that we should pick a privileged region not with the *same* laws, but with the *strongest* laws.

> *Strongest Region*: Given a region *R* of a world, choose a generally connected region that contains *R* and has the strongest relativized laws.

Here, strength is understood in the same way as it is for Lewis, in terms of informativeness. *Strongest Region* allows us to accommodate the counterexample above to *Largest Region*. *Strongest Region* forces us to pick a region that includes enough x-particles colliding and exploding. Such a region contains stronger laws, since a system that includes "all x-particles explode when they collide" is more informative about the world above than one that excludes it.

Unfortunately, *Strongest Region* does not work either. The problem is that in some cases, picking the region with *weaker* laws gives us the desired result, but *Strongest Region* forces us to pick a gerrymandered region with stronger laws. For example, consider a world with many stationary x-particles, some of which have spin-up and some of which have spin-down. Suppose that the particles with spin-up are located on one side of the world and the particles with spin-down are located on the other side of the world, but there is a sprinkling of x-particles with spin-up among the particles with spin-down (see Figure 1). Consider one such x-particle with spin-up that is located near x-particles with spin-down at a point *p*. What are the laws at *p*?

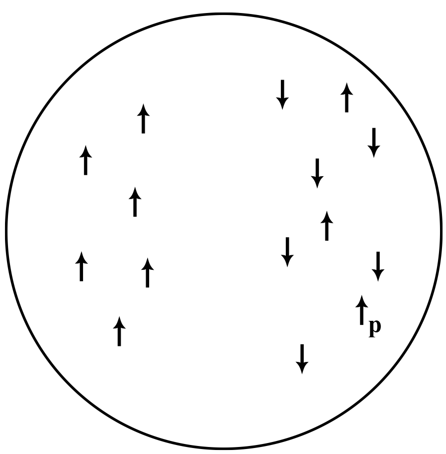

Figure 1: A world with x-particles, where up-arrows and down-arrows represent particles with spin-up and spin-down respectively

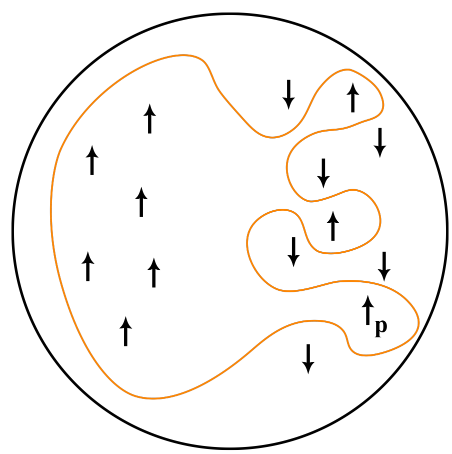

Figure 2: A gerrymandered candidate privileged region

Intuitively, the laws at *p* are weak. There are many x-particles near *p* that have spin-down, so we would not want to say that the laws at *p* are robust and include “all x-particles have spin-up”. But note that *Strongest Region* does not get that result. Instead, we are forced to pick a region with the strongest laws that contains *p*, a highly gerrymandered region (see Figure 2). This seems like the wrong result.

Here is another problem. Roughly, the problem is that we want to allow some kinds of holes but not others, but *Strongest Region* cannot accommodate this since it requires all privileged regions to be generally connected. (*Largest Region* had this problem too.) For an example of holes that we do *not* want to allow, recall the world from §3.2 which has many x-particles that collide, where some acquire spin-up and some do not, evenly distributed through the world. Suppose two x-particles come close to colliding, but just miss each other. If we want to know what would have happened if they had collided, we cannot look to the laws of a region that only contains x-particles that acquire spin-*up* on colliding by “poking holes” in the region to ignore all the instances of x-particles acquiring spin-*down*. It is relevant that around the two x-particles, there are many x-particles that acquired spin-down as well as spin-up. For an example of holes that we *want* to allow, consider a world with x-particles and two concentric spherical regions *A* and *B*, where *B* is contained within *A*. In *B*, all x-particles are charming, and in *A* but outside *B*, all x-particles are flavorful. It seems it is a law in the region *A*-excluding-*B* that all x-particles are flavorful. But since *Strongest Region* requires regions to be generally connected, and *A*-excluding-*B* is essentially a region with a hole, we do not get this result. In short, it is not clear how to make a principled distinction between desirable and undesirable holes in regions.

Here is a third proposal. The rough idea is that we should try to incorporate the best of the previous two proposals, *balancing* the strengths of each.

> *Balanced Region*: Given a region *R* of a world, choose a connected region of the world that contains *R* which best balances the strength of the relativized laws with the size of the region near *R*. [24]

First, note that this proposal requires us to *balance* size and strength. We may choose a privileged region relative to which there are less strong laws, in order to make a large gain in the size of the region, or choose a smaller region in order to make a large gain in the strength of the laws that hold relative to the region. Note also that on this proposal, given a region *R* we are required to maximize not the size of the privileged region in general, but the size of the region *near R*. That is, for a region *R*, a privileged region that is very large but contains few spatiotemporal points near *R* is not to be favored over a privileged region that is perhaps slightly smaller, but contains many spatiotemporal points near *R*.

Balanced Region accommodates both types of counterexamples to the previous two accounts. *Balanced Region* handles the counterexample to *Largest Region*. In that world, where we are considering what the laws are in the region where two x-particles nearly collide, *Balanced Region* tells us to pick a privileged region that contains many x-particles (perhaps even the whole world), since such a region would be both larger *and* contain stronger laws. *Balanced Region* also handles the counterexample to *Strongest Region*. It would tell us to pick a privileged region that is large and contains many x-particles near *p*, even though this would mean a region with weaker laws.

[24] Note that there may be cases in which there is no region of the world which *best* balances strength and size, say in very irregular worlds, worlds unlike Humongo in which there are not even local regions of regularity. So, we are left with several candidate privileged regions that perform equally well. In that case, say that the absolute laws of some region *R* are the laws that all of these candidate privileged regions have in common. In sufficiently irregular worlds, this will result in *R* have no or very few laws. Note that this is the same strategy employed by Lewis (1973a: 73) and Loewer (2004: 1119) for worlds that have ties for the best system.

Finally, note that *Balanced Region* only requires regions to be connected, not generally connected. That is, the proposal allows a region with holes, as long as it best balances size and strength near the region in question. In the world above with colliding x-particles, some of which explode and some of which don't, *Balanced Region* likely would disfavor any privileged region that has holes around all the x-particles with spin-down, since such a region would need to leave out nearby spacetime points. On the other hand, in the world that contained the two concentric spherical regions, *A* and *B*, *Balanced Region* would likely select *A-excluding-B* to be a privileged region, since if we included a part of *B*, we would get laws that are considerably less strong at only a small gain in size, whereas if we left out a part of *A-excluding-B*, we would get a smaller region with no gain in strength of the laws.

There is one minor problem remaining to be addressed. The problem is that we have not successfully eliminated all relativity from the account. Since we allow privileged regions to overlap, in some cases, we allow different incompatible laws to hold at the same spacetime point. Consider a world that contains many x-particles and two partially overlapping regions, *X* and *Y*. Call the region where they overlap "*Z*". Suppose that all the x-particles in *Z* are purple, all the x-particles in *X*-but-not-*Z* are orange, and all the x-particles in *Y*-but-not-*Z* are blue. Now, consider a spacetime point *p* located within *Z*. The problem is that the laws at *p* vary depending on which region we consider. If we ask what the laws are at *Z*, *Balanced Region* tells us to pick a privileged region containing *Z* that best balances strength of the laws and size near *Z*. It seems this region is *Z* itself. So, the absolute laws analysis tells us that the laws at *Z*, and therefore also at the point *p*, include "all x-particles are purple". On the other hand, if we ask what the laws are at *X*, *Balanced Region* tells us to pick a privileged region that contains *X* which best balances strength of the laws and size near *X*. It seems this region is *X* itself. So, the absolute law analysis tells us that the laws at *X*, and therefore at the point *p*, do *not* include "all x-particles are purple". So, we have not successfully given an account of *absolute* (non-universal) laws since different incompatible laws can still hold at the same spacetime point.

Here is a final proposal. The rough idea of this proposal is that we should start with *worlds* not *regions*, carving up the world into a collection of *privileged regions* that form a partition (are mutually exclusive and exhaustive). More precisely,

> *Definition*: A *partition* ∏ *of a world w* is a collection of regions of *w* such that every pair of regions in ∏ is disjoint and every spacetime point of *w* is a part of some region in ∏.[25]

Now, here is the proposal:

> *Balanced Partition:* Choose a partition of the world such that its regions are connected that best balances the strength of the laws of each member region with the size and closeness of its member regions.

Unlike with *Balanced Region* where we start with a region *R* and we consider the size of the privileged region *near R*, *Balanced Partition* tells us to incorporate size and closeness of its member regions in *general*. To incorporate closeness of its member regions in general, a partition is favored when it contains regions such that the spatiotemporal points that each region contains are closer to *each other*, as opposed to farther apart from each other. Just like with *Balanced Region*, this clause in *Balanced Partition* disfavors gerrymandered regions.

Let's try applying the proposal to understand it. If we go back to Humongo, *Balanced Partition* tells us to carve the world into connected regions that best balance size and closeness

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[25] This is partly an adaptation of the set-theoretic definition of a partition. See Enderton (1977: 57). "A partition ∏ of a set *A* is a set of nonempty subsets of *A* that is disjoint and exhaustive, i.e.,

a) no two different sets in ∏ have any common elements, and
b) each element of *A* is in some set in ∏."

against the strength of the laws. It seems that we should carve the world into the many regions which correspond to the duplicates of worlds from the set Ω and which correspond to the paths of these duplicates in spacetime. When we specify the relativized laws in each region, we only consider the spacetime points composing each region, so we can ignore the relations between particles of *different* duplicates of worlds.[26] This gives us simple laws for each duplicate of a world. So, for example, the laws at any point in twin-$w_@$ will be the laws of our world, and the laws at any point in twin-w_N will be the laws of w_N.

Further, this proposal deals with all the counterexamples to the previous proposals. First, *Balanced Partition* avoids the counterexamples to *Largest Region* and *Strongest Region*. The explanations are the same as the explanations for *Balanced Region*, since *Balanced Partition* also balances both size and closeness together with strength of the laws. Second, *Balanced Partition* deals with the counterexample to *Balanced Region*. Since we are required to build a partition, privileged regions will not overlap, so different laws cannot hold at the same spacetime point depending on which region we consider. For example, in the world above with orange, blue and purple x-particles, *Balanced Partition* would likely instruct us to carve the world into the following regions: *Z*, *X*-but-not-*Z*, and *Y*-but-not-*Z*.

Finally, let me discuss two potential objections that will help clarify the view I have defended. Here is the first objection.[27] You may worry that although *Balanced Partition* can

[26] Here is an illustration. (See Footnote 11). Suppose there is a world *w* in Ω such that its particles can be described by a simple function *f*. The problem with the BSA was that since the duplicates of worlds in Humongo are moving in a very complicated way relative to each other, the particles of twin-*w* move in a very complicated way relative to the other particles in the world, in a way that is not correctly described by *f*. However, on *Balanced Partition*, to describe the laws of twin-*w*, we systematically ignore all the spacetime points outside of twin-*w*. So, when we systematize twin-*w* to get its relativized laws, we completely ignore the spatiotemporal relations between twin-*w* and the particles in the rest of the world. So, restricting our attention *only* to the spacetime points of twin-*w*, it would be correct to say that the particles of twin-*w* act in accordance with *f*. To speak loosely and metaphorically, *Balanced Partition* tells us to treat the privileged regions of a world almost as if they are isolated worlds themselves, like the worlds of David Lewis's modal realist pluriverse.

[27] Thank you to an anonymous referee for raising this objection.

handle worlds that are simple when we "zoom in" but increasingly more complicated when we "zoom out", it cannot handle the converse – worlds that seem simple when we "zoom out" but increasingly more complicated when we "zoom in". For example, consider a world that contains nested structures of universes embedded within black holes.[28] Say there is a parent universe which contains black holes which in turn contain baby universes, which in turn contain black holes, and so on. Suppose that the laws of each baby universe get increasingly more complicated as we go down. How would *Balanced Partition* instruct us to partition the world?

This is not a problem for the account. There are two possibilities – either (1) this spatiotemporal structure bottoms out and after a certain point there are no further baby universes embedded within black holes or (2) it doesn't. If (1), then *Balanced Partition* would instruct us to carve each of the regions in the parent universe that contain black holes into many distinct privileged regions, corresponding to the baby universes with different laws that are embedded within the black holes. Although these privileged regions and baby universes would be inaccessible to physicists in the parent universe, and so the parent universe *appears* to be simple when we "zoom out" of the world, this is not strictly speaking true. The black holes in the parent universe are in reality very complicated regions, which should divide into many privileged regions. If (2), this world consists of an infinite chain of black holes and baby universes. A Humean should see this case as similar to the case of *gunk* (Lewis 1990: 20), an object that divides forever into smaller and smaller parts. In both cases, Humeans can say that the bearers of the perfectly natural (fundamental) properties need not be mereologically fundamental.[29] So, in a

[28] See, e.g., Pathria (1972), Good (1972), and Hawking (1994: Chap. 11). Pathria discusses the possibility that our universe is a black hole. Good discusses the possibility that our universe is embedded within a black hole, and the possibility that there is an infinite sequence of baby universes embedded within the black holes of parent universes. Hawking discusses a similar possibility, in which a black hole in a parent universe is a gateway to the spatiotemporal structure of a baby universe.
[29] See Borghini and Lando (2011) for relevant discussion, in which they argue that a Humean should deny that the bearers of the perfectly natural properties are only mereological atoms.

world with an infinite sequence of black holes and baby universes, a Humean can say that the perfectly natural (fundamental) properties – whatever they are instantiated by – determine the privileged regions of the world, by *Balanced Partition*.

Here is the second objection.[30] You may worry that *Balanced Partition* gets the wrong result in certain cases in which there intuitively seem to be no non-universal laws, but *Balanced Partition* says there are. For example, consider an infinitely large Boltzmann world in which there are only simple statistical mechanical laws that permit a large degree of randomness and hold universally throughout the world. Suppose that there are no other laws in this world. Because of the infinite size of the world and the randomness of the laws, there are large regions of this world that *appear* to have non-universal laws – for example, a region in which all objects obey the EFE and another region in which all objects obey Newtonian laws. *Balanced Partition* would likely instruct us to partition the world into many privileged regions. However, by stipulation, there are no non-universal laws in this world, only universal statistical mechanical laws.

To see how to respond to this objection, let's compare it to an objection that is often raised against Humeanism about laws in general. Consider a world in which there is a single particle moving uniformly through spacetime, yet it is a law that all objects obey the EFE. A Humean account of laws like the BSA would likely not say that the EFE are laws of this world, since they likely would not be in the best system of the world. Adding them to a system would greatly decrease its simplicity and not add much to its informativeness. But by stipulation, the EFE are laws of the world. The objection, in short, is that the laws don't seem to supervene on the non-nomic facts of a world but on the Humean view, they do. My point here, however, is that

[30] Thank you to an anonymous referee for raising this objection.

the second objection about Boltzmann worlds above is, in effect, a novel version of this supervenience objection against Humeanism about laws, specifically against Humean accounts of laws that allow non-universal laws. In this case as well, the intuition is that the laws don't supervene on the non-nomic facts. So, Humeans can treat this objection against my account in the same way that they treat the general supervenience objection against Humeanism about laws.

There are a number of ways in which Humeans have responded to the general supervenience objection (see Footnote 3). For example, some Humeans simply deny the possibility of such worlds – they deny that there is a metaphysically possible world that has complicated laws like the EFE but in which there is only a single particle moving uniformly through spacetime. (On the Humean view, the laws don't govern or constrain the behavior of the non-nomic facts of a world – they are merely descriptive generalizations of the non-nomic facts – so Humeans need not accept the possibility of worlds with complicated laws but simple regularities.) So, in response to the Boltzmann world objection, we may do the same – we may deny that there are metaphysically possible worlds that have only simple statistical mechanical laws but that exhibit complicated regularities like the ones described above. (Note I am not suggesting there are no metaphysically possible worlds that exhibit complicated regularities like the ones described above; I am merely suggesting that there are no worlds that exhibit such complicated regularities *and* have only simple statistical mechanical laws.)

§5 Consequences

In this final section, I explain the consequences of this account of non-universal laws on theories of counterfactuals and causation.

§5.1 Absolute Non-Universal Counterfactuals and Causation

Here is an immediate advantageous result of the final proposal from the previous section, *Balanced Partition*. Since the regions of a partition are mutually exclusive and exhaustive, it tells us what the laws are in Humongo, everywhere and absolutely. As a result of this, we can default back to Lewis's analysis of counterfactuals and causation, discussed §1, where a counterfactual is evaluated by comparing nearby possible worlds and a causal claim is evaluated in some way that is determined by counterfactual facts.[31]

As before, closeness of worlds will vary due to factors like conversational context, but in most cases, the metric will default to something like Lewis's standard resolution. There is a small issue, however. In Lewis's original formulation, we are told to avoid "big, widespread, diverse violations of law" as well as "small, localized, simple violations of law", but this is impossible in worlds with non-universal laws like Humongo, since in such worlds, there are violations of law *w*ithin the world *itself*. For example, the absolute laws of twin-$w_{@}$ are violated in twin-w_N, and this leads to issues when evaluating counterfactuals. For example, recall that twin-Pelé kicks a ball that flies in Humongo. Now, consider w_1, which is a world very much like the actual world – it is much smaller than Humongo and contains no other duplicates of possible worlds – except in which twin-Pelé does not kick the ball and it does not fly. Finally, consider w_2, which is a world very much like Humongo, except also in which twin-Pelé does not kick the ball and it does not fly. Lewis's standard resolution gets the result that w_1 is closer to Humongo than w_2, because the latter contains big, widespread, diverse violations of non-universal, absolute law (in other privileged regions of the world), which is of first importance to avoid, even though

[31] As before, I am relying on Lewis's account of counterfactuals and causation for ease of exposition. But this will not affect the points made, since all that is needed for our purposes is the assumption that the laws of nature play a role in determining counterfactual and causal facts.

the former perfectly matches Humongo more in terms of particular fact. So, we get the result that "if twin-Pelé had not kicked his ball, the world would be much smaller than it is".[32] So, we need a new way of understanding a violation of law that is compatible with worlds with non-universal laws in which there are violations of law within the world itself.

The solution is quite simple. Intuitively, these sorts of "violations" are not the type of violations that matter for our purposes; violations of law *between* privileged regions within a world should not play a role in the closeness relation between worlds that we use to evaluate counterfactuals. Instead, the types of violations of law that are relevant are the violations that, roughly, occur within a privileged region itself. For example, in twin-$w_@$ in Humongo, all objects act in accordance with the EFE, so a world like Humongo in which twin-Pelé's ball moves in accordance with *Newtonian* laws of motion in twin-$w_@$ has a violation of Humongo's laws.

> *Definition*: There is a *violation* in a world *w* of the laws of a world *w'* if and only if there is some privileged region *R* in *w'* such that *l* is an absolute, non-universal law of *R* and *~l* is true in *R* at *w*.[33]

For example, on this definition, a world like Humongo in which twin-Pelé's ball moves in accordance with Newtonian laws of motion has a violation of Humongo's laws, since the laws of one of Humongo's privileged regions, twin-$w_@$, entail that twin-Pelé's ball does not move in

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[32] Thank you to Christopher Meacham for raising this example to me.

[33] This is a *de re* modal claim, so on some views, such as Lewis's (1986) modal realism, this definition will need to be understood in terms of counterparts. That is, Lewis will understand the expression "*~l* is true in *R* at *w*" above as saying *~l* is true in some region *R'* in *w* such that *R'* is a counterpart of *R* (sufficiently similar to *R*). What counts as "sufficiently similar", and therefore, which regions will be counterparts of other regions, will again vary based on factors like conversational context. This is in line with how Lewis understands *de re* modal claims, such as when Lewis (1979: 467) claims the counterfactual "if Nixon had pressed the button, there would have been a nuclear holocaust" is true if and only if some world in which *Nixon* presses the button and there is a nuclear holocaust is closer to the actual world than any world in which *Nixon* presses the button but there is no nuclear holocaust. On Lewis's view, "Nixon" here is understood as our world-mate Nixon's *counterpart*.

accordance with Newtonian laws of motion. Further note also that neither w_1 nor w_2 from the example above contain big, widespread, diverse violations of law on the *new* definition, but w_2 perfectly matches Humongo very well in terms of particular fact. So, now, Humongo, comes out closer to w_2, and "if twin-Pelé had not kicked his ball, it would not have flown" comes out true while "if twin-Pelé had not kicked his ball, the world would be much smaller than it is" comes out false. Further, again using Lewis's (naïve) analysis of causation, we get the result that twin-Pelé's kicking the soccer ball caused it to fly.

§5.2 Interregional Interaction

There is a lingering issue. The issue is that regions can overlap with multiple privileged regions of the partition. On the present analysis, there is always indeterminacy in the laws of such regions, because the absolute law analysis above requires the region to be contained within a *single* privileged region of the partition. For example, if we ask what the laws are in Humongo, *Balanced Partition* gives no determinate result, since the region Humongo is not contained within a single privileged region. This may not seem like a serious issue, since there are no laws that hold universally in Humongo and in any case, we do have an answer to what the laws are at any spacetime point within Humongo.

But recall the world Giganto III from §2, which contains *only* non-overlapping duplicates of two worlds. Say these two worlds are the actual world and a world that has the same laws as those of the actual world except differs radically in its laws of electromagnetism and radioactive decay.[34] Let the respective duplicates in Giganto III be called "R_1" and "R_2". First, as I just mentioned, our analysis gets no determinate result for the laws of Giganto III, since due to the differences in their laws, presumably *Balanced Partition* would partition the world into R_1 and

[34] Thank you to an anonymous referee for suggesting this example.

R_2, and Giganto III overlaps with multiple privileged regions. But there *are* laws that hold universally in Giganto III! For example, throughout the world, it seems that it is a law that all objects act in accordance with the law of conservation of mass – in other words, nowhere in the world is mass ever spontaneously created or destroyed. But the absolute law analysis together with *Balanced Partition* cannot accommodate this intuition.

Second, and more seriously, as a result of this, we get the wrong results when considering counterfactuals that involve multiple privileged regions. For example, suppose twin-Maradona stands in R_1 near the boundary between the two regions, kicks a ball (with no charge) across the boundary against a window in R_2, and the window shatters. As a result of the fact that there are no laws that hold universally in Giganto III, the counterfactual "if twin-Maradona had *not* kicked the ball, the window would have still shattered" comes out true. To see why, consider a world in which twin-Maradona does not kick the ball, but a ball spontaneously emerges from the boundary between the two regions. Note this world is closer to Giganto III than any world in which twin-Maradona does not kick the ball and it does not shatter. This is because on the present analysis, none of the worlds in question have laws that hold universally in the world, that is, across both regions. So, no law of conservation of mass is violated as the particles of the ball spontaneously pop into existence in R_2 at the boundary. Further, the former possible world differs from Giganto III less in terms of particular fact than any of the latter possible worlds – the respective counterparts of R_2 are qualitative duplicates of R_2.

For similar reasons, if in Giganto III, twin-Maradona decides *not* to kick a second ball, we get the result if he *had* kicked it, the ball would never have made it across the boundary and instead the particles of the ball that cross the boundary would have simply vanished before they entered R_2. Further, we get the result that in the first case above, twin-Maradona's kicking the ball did not cause the window to shatter – in Giganto III, it simply happened to be the case that a ball just like twin-Maradona's coincidentally emerged from the boundary while twin-Maradona's ball spontaneously disappeared as it crossed the boundary. In short, the present analysis does not allow any kind of interregional causal interaction between privileged regions, even though it seems there should be.

The issue, again, is that the analysis does not get the result that laws hold *across* privileged regions, even in cases in which the analysis says there are laws in common between the two regions. So, in order to address this problem, we need to make a small change to the absolute law analysis from §4.2. While earlier, we said that a region must be contained within a single privileged region to have non-universal laws, now we will say the following.

> *Final Absolute Non-Universal Law Analysis*: *l* is an *absolute* law of a region *R* if and only if, for *every* privileged region *P* that *R* overlaps with, *l* is law relative to *P*.

This analysis ensures that when a region *R* overlaps with multiple privileged regions, there can be laws that hold throughout *R* as long as all of the privileged regions that *R* overlaps with have those laws according to *Balanced Partition*. Further, note that the previous absolute law analysis is a special case of this one; to say a region is contained within a single privileged region is just to say that it overlaps with only that privileged region. Then, we need to make a small change to our definition of a violation of a non-universal absolute law of a world. While earlier, we said that only the laws of the *privileged* regions of a world are relevant for determining violations, now, we will say:

> *Definition*: There is a violation in a world *w* of the laws of a world *w'* if and only if there is some *region R* in *w'* such that *l* is an absolute, non-universal law of *R* and ~*l* is true in *R* at *w*.

This ensures that the laws of a world can be violated when the laws that hold between privileged regions are violated, more specifically, when the laws of regions that overlap with multiple privileged regions are violated.

Here are a few examples to understand the consequences of this proposal. First, we get that in Giganto III above, there are some laws that hold universally in the world, like the law of conservation of mass. This is because although Giganto III overlaps with multiple privileged regions, in every privileged region that it overlaps with, it is a law that all objects act in accordance with the law of conservation of mass. Similarly, although there are not any laws that hold universally in Humongo, there can be laws that hold across multiple privileged regions, as long as these privileged regions have laws in common.

Second, in the case of twin-Maradona in Giganto III above, we get that a world in which twin-Maradona does not kick the ball but a ball spontaneously emerges from the boundary between the two privileged regions has a violation of the laws of Giganto III, more specifically, a violation of the law of conservation of mass that holds in a region that overlaps both privileged regions. So, a world in which twin-Maradona kicks the ball and the window shatters is closer to Giganto III than any world in which he kicks the ball and it does not shatter. So, we get the result that if he hadn't kicked the ball, the window would not have shattered, and his kicking the ball caused it to shatter. Similarly, in the case of the second ball which twin-Maradona does not kick, we get the result that if he *had* kicked it, it would have made it across the boundary, since if it hadn't, that would have involved a violation of Giganto III's laws.

Third, consider another world, Giganto III*, consisting of two privileged regions, R_3 and R_4 such that the objects in one obey the EFE and the objects in the other obey Newtonian laws of motion. Suppose twin-Rooney stands in the first region, kicks a ball which arcs around a large planet in accordance with the EFE in the first region, then travels across the boundary, moves in uniform motion in a straight line in accordance with the Newtonian laws of the second region, and then collides with a comet. Now, consider the counterfactual "if twin-Rooney had not kicked the ball, it would not have collided with the comet". Clearly, this counterfactual is true, and it is true precisely because the ball acts in accordance with the laws of the first region *and then* acts in accordance with the laws of the second region. The new analysis can also deal with this example. A world in which the laws of *either* region are violated – say, where the ball acts in accordance with Newtonian laws in R_3 and then acts in accordance with the EFE in R_4, or where the ball acts in accordance with neither regions' laws – is farther from Giganto III* than a world in which there are no such violations. So, the analysis can allow for interregional interaction involving *different* laws as long as there are also laws that the regions have in common.

Fourth, and finally, you may worry that this account leads to contradiction, because of cases in which the laws of two adjacent interacting regions conflict. So, consider a final world with two regions R_5 and R_6, such that it is a law in R_5 that all objects are always accelerating, and it is a law in R_6 that all objects are always at rest. Suppose an extended mereologically simple object accelerates towards the boundary between R_5 and R_6. The object is extended in the sense that it is much larger than a single point and so can overlap with both regions when it is near the boundary, and it is a mereological simple in the sense that it is not composed of smaller parts. Can the object cross the boundary?

The key is that, given plausible assumptions about acceleration and rest, there is no metaphysically possible world in which an extended mereologically simple object overlaps with regions that have the laws described above. Perhaps in some worlds, the object changes directions and accelerates away from the boundary, in other worlds, it decelerates and so moves slower and slower towards the boundary never reaching it, or in other worlds, the universe ends just before it reaches the boundary. But it could never cross the boundary, so we don't have to say that the same object could accelerate and be at rest at the same time.[35] Of course, whether the laws of interacting regions *do* conflict in a way that leads to metaphysical impossibility will depend on the specifics of the laws.[36]

§6 Conclusion

Let me summarize the conclusions of this paper. First, Lewis's Humean account cannot accommodate non-universal laws to the extent we require, especially in worlds like Giganto Jr. and Humongo. Second, a relativized non-universal account does not work, since it entails radical relativism and since substantial constraints are needed on what sorts of regions the laws can hold of. Third, a Humean *can* accommodate non-universal laws, by requiring them to be absolute and by adding such constraints (as described by *Balanced Partition*). Fourth and finally, a Humean can make sense of non-universal absolute counterfactual and causal facts, even ones that involve interregional interaction. In summary, I defended an account of Humean absolute, non-universal laws, and a corresponding theory of absolute counterfactuals and causation.[37]

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[35] So, any counterfactual beginning with "if the object had crossed the boundary" has a necessarily false or impossible antecedent. On some analyses, like Lewis's (1973a: 24-26), such counterfactuals come out vacuously true, while on other analysis, such as Kment's (2014), they come out false.

[36] To give another example, in some cases, there will be conflict at the boundaries between the laws of two different regions when the laws are differential equations, which describe the behavior of objects in infinitesimal neighborhoods of points. For example, consider the most precise formulation of the mathematical consequence of Newton's second law (Maudlin 2007: 11), $\boldsymbol{F} = m\frac{dv}{dt}$, which describes the relationship between force, mass, and the derivative of velocity with respect to time. But we get the derivative of velocity with respect to time, by roughly, examining the change in velocity given infinitesimally smaller and smaller changes in time. If this law holds at the boundary between two temporal regions, the law will have implications for what happens after the boundary. This may conflict with other laws that hold after the boundary. Depending on the specifics of the case, we may have to say that some of these situations are metaphysically impossible, or *Balanced Partition* may instruct us to partition the world so that the boundary (or some transitional region around the boundary) is its own privileged region. Again, however, the point is that whether there is conflict will depend on the specifics of the laws.

[37] It is worth noting that while I have offered a way for the *Humean* to accommodate non-universal laws, anti-Humeans may see the complexity of my solution to be yet another reason to favor anti-Humeanism over

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Humeanism. That said, as I explained in §1, my goal is just to offer a solution to the problem of non-universal laws to *Humeans*, and defending Humeanism over anti-Humeanism goes beyond the scope of this paper.

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