Humean Nomic Essentialism*

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Abstract

Humeanism – the idea that there are no necessary connections between distinct existences – and Nomic Essentialism – the idea that properties essentially play the nomic roles that they do – are two of the most important and influential positions in the metaphysics of science. Traditionally, it has been thought that these positions were incompatible competitors.

We disagree. We argue that there is an attractive version of Humeanism that captures the idea that, for example, mass essentially plays the role that it actually does in the laws of nature.

In this paper we consider the arguments that have lead many to conclude that Humeanism cannot be combined with Nomic Essentialism; we identify the weaknesses in these arguments; and we argue in detail that a version of Humeanism based on a variant of the Best System account of laws captures the key intuitions behind nomic essentialism.

Here is an intuition: Nothing can be *mass* if it doesn't act like *mass*. This might seem trivial – of course mass has to act like mass, how could it do anything else? But we can understand the intuition better when we consider certain modal claims: The intuition is that if there is some possible world where some property, P, doesn't act like mass does in our world then P *is not mass*. If in some other world a property, Q, acts just like the economic property of inflation acts in our world then Q (whether or not it's ever instantiated in our world) *is not mass*. This implies that in any possible world if there is the property mass then that property must act like mass does in our world. That is to say, it is *necessary* that the property mass acts in the way it does in our world – it plays the *mass-role* necessarily.

This is an attractive thought. A similarly attractive intuition runs in the other direction: If something *acts like* mass – for instance, determining the degree to which a body resists changes in its motion – then it *is mass*. If we know that some property plays the mass-role then we don't need to do any further investigation to find out what it is – it's mass. And if we find a property P and a property Q that both play the mass-role, then P and Q are the same property – *mass*. Anything that fills the mass-role is necessarily mass.

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We'll use the term 'Nomic Necessitarianism' to refer to the class of views which capture these intuitions. Specifically, we will count a view as a nomic necessitarian view if it says that (i) a physical property possesses its nomic role – its role in the physical laws (whatever, ontologically, those laws happen to be) – as a matter of metaphysical necessity and (ii) as a matter of metaphysical necessity, no other property possesses that nomic role. That is, a nomic necessitarian view says that, necessarily, P is mass if and only if it plays the mass-role.

Nomic necessitarianism is often accepted as part of a larger view which says that the *essence* of a property is its nomic role. The idea is that, as we discover more about what mass's nomic role is in our world, we are thereby discovering *what it is to be* the property, mass – *the defining feature* of property mass is that it plays that particular nomic role. Call this view *nomic essentialism*. For now, we will focus on nomic necessitarianism. Towards the end of the paper we will extend our reasoning to nomic essentialism.[1]

There are a variety of different ontological positions that necessitarians could take in developing their view. Often, these involve some variation on the notion of *powers*, whether these be causal powers, essential dispositions to do X under stimulus Y, or essential 'capacities' to exhibit certain law-like behavior, among others. (For variants of these views see, e.g., Shoemaker (1980), Ellis (2007), Swoyer (1982), Bird (2007), Mumford (2004), Vetter (2015), Chakravartty (2003), Cartwright (1989).) On such views, for something to have mass, it must necessarily possess certain powers (or dispositions, or something similar), and any property that confers those powers thereby plays the mass-role.

But, notably, these ontologies seem to be inconsistent with a *Humean* metaphysics. Roughly speaking, the Humean thinks that there are no necessary connections between distinct existences. This view is often developed by giving an account of laws, and related notions, that reduces them to the patterns of local events spread out across spacetime. In fact, it's commonly thought that it is impossible to have *any* nomic necessitarian view that is compatible with the Humean worldview – that there is an inconsistency between the Humean approach and saying that properties have their nomic roles as a matter of metaphysical necessity.

The aim of this paper is to show that a Humean *can* capture nomic necessitarian and nomic essentialist intuitions. We can, contrary to what many have thought, combine the sparse Humean metaphysics with an account of physical properties according to which, necessarily, a property is mass just in case it plays the mass-role.[2]

[1] Important terminological note: People sometimes use the term 'necessitarian' to refer to views like Armstrong's (1983) and Dretske's (1977) which do not capture the above intuition and instead say that laws consist in the holding of a 'necessitation' relation between universals. (See, for example, the PhilPapers.org page on 'Necessitarianism' (Schrenk, 2020).) But often it's used in the way we are using it (for example, in the Stanford Encyclopedia Article on laws of nature (Carroll, 2016) and Bird (2007)).

[2] This Humean nomic essentialism should not be confused with views like Demarest's (2017), which combine an *anti-Humean*

We start in section 1 by discussing the motivations for nomic necessitarianism. Section 2 describes Humeanism in more detail and considers the line of thought that has convinced many that Humeanism is inconsistent with nomic necessitarianism. Section 3 argues that this line of thought is not as conclusive as it may seem and actually allows an opening for a certain type of Humean nomic necessitarianism. In section 4 we appeal some previous work of ours – specifically the 'Two-State Humean' approach that we developed in Bhogal and Perry (2017) – to show how a Humean account can capture the nomic necessitarian intuition, at least with respect to a certain class of properties. In section 5 we discuss some possible limitations of the view. In section 6 we show how the argument extends to the nomic essentialism intuition.

1 Motivating Necessitarianism

Let's start by considering the motivation for nomic necessitarianism, the view that something is *mass* just in case it plays the *mass-role*.

The main argument for nomic necessitarianism is *epistemic*. Here's a case: Take the property, P, which plays the mass-role in our world – that is, determining the degree to which an object resists changes in its motion when impressed by external forces and determining the strength of the gravitational field that object produces – and imagine it plays the charge-role in another world, w_1 – that is, determining the strength with which an object repels like-charged entities and attracts oppositely-charged ones.

P plays the mass-role in our world but plays the charge-role in w_1. Conversely, imagine that the property, Q, which plays the charge-role in our world, plays the mass-role in w_1. Suppose this switch in the roles of P and Q is the only difference between the two worlds.

So we have two worlds, the actual world and w_1, which, in one sense, differ tremendously: the fundamental physical properties are distributed in vastly different ways in the two worlds and those properties play very different roles in the laws of the two worlds – the pattern of instantiation of P and Q differ hugely between the two worlds. However, in another sense, the actual world and w_1 are extremely similar. Indeed, 'from the inside' they would be in-principle indistinguishable by observation or physical measurement. Our ability to investigate the world, scientifically, is only able to tell us that some property occupies the mass-role, not whether the property occupying it is P or Q. This is the point that Lewis (2009) is making when he says: 'To be the ground of a disposition is to occupy a role, but it is one thing to know that a role is occupied, another thing to know what occupies it'.

The idea is that we receive evidence about properties, and their instantiations, via their causal influence on the world. Specifically, our evidence about properties comes from their causal influence on our sense

nomic essentialist ontology with a Humean style account of laws.

organs. As such, the evidence we have for the existence and instantiation of a property is only ever evidence for there *being something* playing a particular nomic role. If P plays a particular role in one world, and so affects our sense organs in a certain way, this is indistinguishable from a world where Q plays that exact role and has the same effect on our sense organs.

For the nomic non-necessitarian, then, there are features of the world that are entirely epistemically blocked off to us, namely, *what* properties are playing a particular role. That is, it is a fact that P, or Q, or some other property plays the mass-role, but we can't know which property plays the role. Properties like this are called "quiddities" (from the latin '*quid*', or 'what'). Perhaps more problematically, for properties that are quiddities, the fact that the property instantiated at a given world is P rather than Q does nothing to constrain the physical behavior of the things instantiating P.

The necessitarian does not face these issues. For them, once you've fully specified a property's nomic role at some world, there is nothing left to know. Mass necessarily plays the mass-role, and the mass role is necessarily played only by the property mass so there cannot be two different worlds which differ merely quiddistically. That is, there cannot be two worlds that agree about what roles are being played (there is something playing the mass-role, and something playing the charge-role, and so on) but differ only in *what* properties are playing those roles.

The necessitarian view has the advantage, then, that it does not commit to these undetectable features of the ontology. There is no epistemic gap between the role that some property plays and the identity of the property.

The second advantage of necessitarianism is a closely related one. The core nomic necessitarian intuition meshes very well with our conception of scientific practice as a means of investigating and theorizing about the physical world. The necessitarian can more satisfactorily explain how the practice of science helps achieve its aims, as Lewis describes them:

> Thus the business of [physical science] is not just to discover laws and causal explanations. In putting forward as comprehensive theories that recognise only a limited range of natural properties, physics proposes inventories of the natural properties instantiated in our world. Of course, the discovery of natural properties is inseparable from the discovery of laws. For an excellent reason to think that some hitherto unsuspected natural properties are instantiated - properties deserving of recognition by physics, the quark colours as they might be – is that without them, no satisfactory system of laws can be found. (Lewis, 1983, pp. 364-365)

For Lewis, one of the key roles of our fundamental empirical science is to discover what the (perfectly) natural properties instantiated at our world are – the ones in terms of which our physical laws, and the

best systematization of the world in general, are most perspicuously formulated. But, if it's epistemically inaccessible to us whether the mass-role is played by P or Q, then physical science could not tell us what natural properties are instantiated at our world. It would only tell us that *some* property or other plays that role.

Again, necessitarianism avoids this problem by removing the epistemic gap between the role that some property plays and the identity of the property.

There are significant attractions to the necessitarian position, but it has traditionally been thought that the Humean about laws of nature cannot enjoy these attractions. In the next section we will consider why people have thought this.

2 Necessitarianism and Humeanism

It's widely accepted that the Humean cannot capture the necessitarian intuition. And many (e.g. Bird (2007, section 4.2), Ellis and Lierse (1994, p.30), Lierse (1996)) have taken this to be a decisive reason to reject Humeanism. In this section we will look at a common line of thought that suggests that the nomic necessitarian intuition is inconsistent with Humeanism. While this line of thought is powerful it does not totally preclude a Humean necessitarianism. In fact, it points us towards the features that a genuine Humean necessitarian view must have.

2.1 Humeanism and Necessary Connections

Let's start by characterizing Humeanism more clearly. The core Humean intuition, stemming directly from the work of Hume, is a denial of necessary connections:

(NNC) There are no necessary connections between distinct existences.

A necessary connection obtains between two entities when the existence or state of one entity metaphysically entails that some other entity must exist or occupy a certain state. For entities to be 'distinct existences' is for them to be, roughly understood, wholly different things. Consider, as a contrast, a pair, A and B, where A is a proper part of B. In that case, A and B are not distinct existences, even though they *are* numerically distinct. Similarly, the property *being scarlet* isn't a distinct existence from *being red*. Necessary connections between these non-distinct existences don't violate Humeanism. If you're a fan of grounding talk, you can say that A and B are distinct existences if and only if they have wholly non-overlapping grounding chains (that is to say, neither partially grounds the other and they don't have a common partial

ground).

(NNC) provides a constraint on Humean metaphysics, but there are a variety of different ontological pictures that can satisfy this constraint. Nowadays the most common ontological picture appeals to the *Humean Mosaic*. The mosaic consists of the intrinsic physical state of each spacetime point (or each point-like object) and the spatiotemporal relations between these points. Humeans often claim that all the facts about the world – including, notably, all the nomic facts, reduce to the Humean mosaic (Lewis, 1986, pp. iv-vi).

This claim that all the facts reduce to the mosaic satisfies (NNC) because the reduction claim implies that the fundamental facts are assignments of intrinsic states to each point, and a state being intrinsic to an entity means that it can obtain regardless of anything else in the world. Hence there are no necessary connections between these states. (Bhogal and Perry, 2017, p. 75)

So, we have a couple of ways of expressing the Humean intuition – the thought that there are no necessary connection between distinct existences and the thought that all the facts about the world reduce to facts about the mosaic.

Given these formulations we can see why nomic necessitarianism seems to be in conflict with the very spirit of Humeanism. We can bring this out in two different ways:

2.2 A Toy Example

Consider a toy scientific law that says 'whenever a spatial point has property A at time, t_n, then it comes to have property B at a later time, t_{n+1}', where A and B are fundamental properties. According to the nomic necessitarian, this law is metaphysically necessary: Any world where it looks like As are not followed by Bs is in fact a world without As (and without Bs) – properties, that is, have their nomic roles necessarily.

If the nomic necessitarian is correct then this law involves a necessary connection between distinct existences. Why? There is a necessary connection between A and B – if a point has A at t_n then that metaphysically necessitates the point having B at t_{n+1}. And A and B are distinct existences. We know this because A and B are fundamental and any non-identical fundamentalia are guaranteed to be *distinct existences*. In grounding terms, if A and B are fundamental entities then this guarantees that A neither grounds B, is *grounded by* B, nor has any grounds in common with B (since they don't have any grounds, period).

So this toy law in conjunction with nomic necessitarianism seems to violate Humeanism. But clearly this result is not specific to our toy law. Other, more realistic laws involving fundamental properties will violate Humeanism in just the same way; they will posit necessary connections between fundamental properties

and entities.

2.3 The Humean Addiction to Quiddities

Here's the second way to see the apparent conflict between Humeanism and nomic necessitatianism. In section 1, we noted that one benefit of nomic necessitarianism is that it avoids having to accept the possibility of two worlds that differ only quiddistically, i.e. worlds that have the very same nomic roles instantiated, and so are indistinguishable to us, but are genuinely distinct due to different properties playing the different roles. But a commitment to merely quiddistic differences between worlds seems to be a consequence of denying necessary connections.

Why is that? If there are no necessary connections between distinct existences, then the instantiation of a fundamental property has no effect on which other properties are possibly instantiated, whether at the same point or elsewhere in the world. This implies that any (logically possible) distribution of fundamental properties across the mosaic is metaphysically possible. Consequently, there can be two metaphysically possible worlds which differ merely in two fundamental properties 'switching' their distribution in the mosaic. And, as we noted earlier, such worlds would be qualitatively indistinguishable.

The Humean, it seems, has to accept that there are possible worlds where fundamental properties switch roles in this way. But nomic necessitarianism denies that properties can switch roles in this way. So, it seems like the Humean can't be a nomic necessitarian.

3 The Strategy

The argument outlined in the previous section suggests that we can't combine the attractions of nomic necessitarianism with those of Humeanism. However, the argument doesn't conclusively show this. To see this, consider again the discussion of the toy law in section 2.2. We argued that the existence of this toy law, in combination with nomic necessitarianism, implied necessary connections between distinct existences. However, it was vital for this argument that we were considering a law involving *fundamental* properties and entities.

The law we considered was 'whenever a spatial point has property A at time, t_n, then it comes to have property B at a later time, t_{n+1}' *where A and B are fundamental properties*. Since A and B are fundamental and non-identical we know that they are distinct existences. And a nomic necessitarian view of this law implies that there is a necessary connection between A and B.

However, if either A or B were non-fundamental, then the argument would not automatically go through – A and B *might not be* distinct existences. And if A and B were not distinct existences, then a necessary

connection between them does not violate (NNC). Consequently, it might be possible for the Humean to allow that there is a metaphysically necessary law that As are followed by Bs – that any world where it appears as if As are not followed by Bs is, in fact, as world without As (and without Bs) – if A and/or B are non-fundamental.

This reasoning provides an opening for a Humean nomic necessitarian view. And it give us a powerful constraint any such view must satisfy. In order to satisfy (NNC) it must be the case that whenever there is a metaphysically necessary law relating A and B *they are not distinct existences* – that is, there's some sort of ontological dependence relation either between A and B, or between A, B, and some more fundamental C, that renders the two non-distinct.

Clearly, developing a nomic necessitarian account of this kind requires a lot of work. That's the aim of the rest of the paper.

3.1 Two Types of Fundamentality

Before moving on, let's highlight one worry you might have about this strategy. We've argued that it's possible to develop a view where non-fundamental properties can be related by metaphysically necessary laws without violating the prohibition on necessary connections, so long as the non-fundamental properties are not distinct existences. Doesn't that mean that it's not possible for the Humean to accept metaphysically necessary laws relating fundamental physical properties?

Is it the case, then, that we can develop a Humean view where, e.g., chemical or biological or economic properties have their nomic roles necessarily, but not properties like mass, charge and spin? An account of Humean nomic essentialism that was only applicable to these special science properties would still be interesting, but it's value would be significantly diminished.

However, we think our proposal *can* apply to fundamental physical properties like mass, charge, and spin. To see this, notice that in this discussion there are two senses of *fundamentality* at work. There is a *metaphysical* sense of 'fundamental' – often glossed as being metaphysically *primitive*, or *un-grounded* – which is how we've been using the term in the paper so far. And there is a *scientific* sense of 'fundamental' – differentiating our most basic science, fundamental physics, from the higher-level sciences, like statistical mechanics, biology, economics, etc.[3]

We've argued that it's possible for the Humean to accept metaphysically necessary laws connecting *metaphysically* non-fundamental properties. If we can give an account of how metaphysically non-fundamental

[3]In fact, many Humeans recently have been clear about this distinction between metaphysical and scientific fundamentality, e.g. Bhogal and Perry (2017), Hicks and Schaffer (2017), Dorst (2019a), Bhogal (fort).

properties can be *scientifically* fundamental then it's possible for the Humean to accept metaphysically necessary laws connecting *scientifically* fundamental properties – those of fundamental physics.

Notice, though, that the standard Humean approach to laws – the Best System account (BSA) – gets us something close to this. It implies that the scientifically fundamental *laws* are metaphysically non-fundamental. Let's see how this works.

On the BSA the laws of nature are the axioms of the best systematization of the facts about the mosaic – where 'best' means the systematization which best balances simplicity and informativeness. Slightly more precisely, consider sets of axioms and the deductive closure of those axioms. Some sets of axioms are informative about the mosaic – their deductive closure tells us a lot about the facts about the mosaics. Some sets of axioms are simple, in the sense of being syntactically simple when written down – there are few axioms and they are syntactically short. The axioms that best balance simplicity and informativeness *best systematize* the mosaic. The axioms of the best system count as the laws (strictly speaking, on the traditional version of the BSA it's only the axioms that are universal generalizations that count as laws). Importantly, given that the simplicity of a system is determined syntactically, there must be a privileged language in which the truths in the system are expressed. For the traditional BSA, this language is one where 'the primitive vocabulary... refer to only the perfectly natural properties' (Lewis, 1986, p. 42).

On this approach, the laws, including the laws of fundamental physics, are not *metaphysically* fundamental – they are grounded in facts about the mosaic. However, we need something that goes further than this. The result we want is that *properties* that are part of the fundamental physics could be metaphysically non-fundamental, even if they *are* scientifically fundamental. The standard BSA doesn't get this result because the laws are restricted to perfectly natural properties, which are metaphysically fundamental.

There are variants of the BSA which relax this restriction though, for example, Cohen and Callender (2009), Loewer (2012b) and Schrenk (2006). But for the purposes of developing a Humean nomic necessitarianism, the most suitable account of this kind is the "Two-State Humean" account we introduced in Bhogal and Perry (2017) (building on a suggestion in Hall (2010)). As we'll see in the next section, the feature that makes our approach suitable for the Humean Nomic Essentialist, that neither Cohen and Callender, Schrenk, nor Loewer have, is the claim that some scientifically fundamental properties exist *in virtue of the same sort of procedure as what generates the laws*. That's what allows the view to avoid the problem of quiddity.

Cohen and Callender and Schrenk's accounts are formulated to allow for special science properties to appear in laws generated by the best system (or some variant of the best system procedure). But, unlike Two-State Humeanism, their accounts don't say that the properties exist in virtue of the same things in

virtue of which the laws exist.[4]

Loewer's Package Deal Account (developed in Loewer (1996); Loewer (2007); Loewer (2012b) and most recently Loewer (fort)) also doesn't give an account where some set of scientifically fundamental properties exist in virtue of the same sort of procedure as what generates the laws. Rather, it gives an account of which properties are *natural*. The upshot of this is that role-switching is still possible on the package deal account. Nothing in Loewer's account prevents property P playing the mass role in one world, and property Q playing that role in another. Loewer's account merely implies that P would be natural in the former world and Q in the latter.

Perhaps a variant of the Package Deal Account could be developed where the properties themselves are generated by the best system procedure, not just their naturalness. We are happy to accept that such a variant of the PDA might be a good candidate for building a Humean Nomic Essentialism. Though for independent reasons we prefer our (2017) approach, but that's not important for our purposes now.

We introduced two-state Humeanism in Bhogal and Perry (2017) as a way to account for the non-separable physical states posited by quantum mechanics, but it can be applied much more widely. As we will see in the next section the specific way this account allows for metaphysically non-fundamental properties to be part of physically fundamental laws will help us to show how a fully Humean account can satisfy the nomic necessitarian intuition. But first we should get the two-state Humean view on the table.

3.2 Two-State Humeanism

The standard BSA starts with the Humean mosaic and generates the laws of nature from that, via the systemization procedure that we described above. The defender of the standard BSA thinks that there are laws of nature, but takes them to be reduced to the Humean mosaic in this holistic way. The guiding idea of Two-State Humeanism is that additional physical ontology can be generated from the mosaic via the same sort of systemization procedure.

In Bhogal and Perry (2017) we used Two-State Humeanism to give a Humean account of the entanglement relationship posited by quantum mechanics. We argued that we can start with a sparse Humean mosaic, one which 'doesn't seem to have any characteristically "quantum mechanical" states in it' (p. 87) and can generate, via the best system procedure, the fact that two particles are in a certain entangled state.

The terminology we used was that the parts of the physical state that are baked into the Humean mo-

[4]These two accounts are also ill-suited to the specific goals of a Nomic Necessitarianism about the scientifically fundamental. Since they are theories about how to apply BSA-type accounts to special science laws, they allow for metaphysically non-fundamental properties to appear in the laws by opening those laws up to apply to *scientifically* non-fundamental properties. But this differs from a Humean Nomic Necessitarian account that is supposed to apply to scientifically fundamental properties.

saic were called the *M-state*, while the parts of the physical state that are generated by this systemization procedure were called the *L-state*. Let's briefly look at how Two-State Humeanism generates the L-state out of the M-state:

Start, for contrast, with the standard BSA. As we noted in the last section, this involves fixing on one particular privileged language in which the axioms are expressed. The standard approach is for this language to be one where 'the primitive vocabulary... refer to only the perfectly natural properties' (Lewis, 1986, p. 42). Two-State Humeanism loosens this requirement: In addition to the primitive vocabulary that refer to only the perfectly natural properties (we call this the 'base language'), Two-State Humeanism allows *any other predicate* to be used in formulating the axioms of the system. But, very importantly, these new predicates must come into the system *uninterpreted*.[5]

How, you might wonder, does uninterpreted vocabulary help one to formulate simple and informative systems? After all, it's uninterpreted, and 'uninterpreted vocabulary' is just a fancy way to say 'meaningless string'. The trick is that, in the context of the total system, what is introduced as uninterpreted vocabulary doesn't remain meaningless.

> [Uninterpreted vocabulary] can have content... if the system contains sentences that contain both novel vocabulary and the already interpreted vocabulary of the base language. For example, a system *S* could introduce a novel, uninterpreted, predicate M(x) ... [and] includes the sentence 'All *M*s are *G*s', where *G* is a piece of already interpreted vocabulary, meaning, for example, "has positive charge". So the novel vocabulary, *M*, is linked to the already interpreted vocabulary (Bhogal and Perry, 2017, p.78)

In fact, such novel vocabulary is often part of the best system of the world for the Two-State Humean. When this is the case, the systemization procedure generates new elements of the physical state. For example, if the predicate M(x) is part of the best system then that means that there is a property that M(x) picks out that is part of the L-state. This property is generated by the systemization procedure and hence is grounded in the whole mosaic, in the same way that laws generated by the BSA are grounded in the whole mosaic.

In Bhogal and Perry (2017) we apply this to the entanglement phenomena of quantum mechanics – saying that such properties are part of the L-state. However, the account can be applied more broadly. For instance, it's fairly natural for the Humean who accepts *objective chance* to take it to be part of the L-state, since Humeans do not take facts about objective chance to be part of the mosaic. And further, Two-State

[5] If we don't have this restriction then Two-State Humeanism falls prey to the 'predicate F problem' which is what motivated the restriction of the language in which best systems are formulated in in the first place (Lewis, 1983, p. 367).

Humeanism allows us great flexibility in which parts of the physical state are in the L-state and which are in the M-state. One extreme view (which we mentioned but didn't endorse in Bhogal and Perry (2017, fn. 6)) is, in the spirit of a suggestion by Hall (2010), that the mosaic merely consists in particles and their positions in spacetime. There are no other features of the mosaic. Properties like mass and charge do exist, but they are part of the L-state – generated by the systemization procedure.

We will discuss this view – call it "positions-first Humeanism" – more later, but the point now is that it illustrates how Two-State Humeanism can allow us to take paradigm physical properties as part of the L-state. If mass and charge are both part of the L-state then those properties are grounded in the whole mosaic. And so, the properties have a common ground – they are not distinct existences. So, if this view is true, there could be a metaphysically necessary law connecting mass and charge, without there being necessary connections between distinct existences.

This thought points the way to how Two-State Humeanism could capture the nomic necessitarian intuition that properties have their nomic roles necessarily. In the next section will be make these thoughts precise.

A quick note on a related view before we move on though: (Esfeld and Deckert, 2017) develop a Humean view that also aims to avoid quiddities, and is similar in structure to a positions-first Two-State Humeanism. Their approach starts with a Humean mosaic that consists just of distance relations between material objects. However, they are extremely deflationary about all other physical properties, saying, for example 'there is no need to admit physical properties at all' (p. 7). As a reviewer points out this deflationism doesn't rise to the level of anti-realism about these properties, because they think that such properties do have extensions. But for Esfeld and Deckert, things like mass, charge, energy and spin are merely 'parameters' of the laws. And the modal character of these parameters is not clear.

Perhaps Esfeld and Deckert would, or should, accept a version of argument that we develop in the next section – in order to establish that things like mass and charge can have their nomic role necessarily. For example, they say that 'parameters... are defined through the functional or causal role that they play for the evolution of the particle configuration' (p.51). But as it stands it's not particularly clear how such a definition of those parameters is supposed to go, and whether the resulting view would imply that parameters like mass have their nomic role necessarily. Further, while they sometimes seem sympathetic to nomic necessitarian-style intuitions, they elsewhere seem to explicitly reject claims that there's a necessary connection between gravitational mass and its nomic role. They explicitly position their view as *opposed* to views which imply that 'the attractive motion of the particles is necessary given masses and the gravitational force', and argue that it's a benefit of their view that such relationships turn out contingent (p.52).

Our aim, unlike theirs, is to argue that the Humean *can* capture these nomic necessitarian claims. We

will bring this view up again when we further discuss positions-first Humeanism in section 5.

4 The Positive Argument

In this section we will argue that the Two-State Humean can capture the nomic necessitarian intuition that properties have their nomic roles necessarily.

The nomic necessitarian view is that two physical properties at two different possible worlds are the same property if and only if they play the same nomic role at their respective worlds. Therefore, we're interested in answering the question of under what conditions two physical properties at two different possible worlds are the same property according to Two-State Humeanism.

For the ordinary Humean, the identity of a property is primitive and independent of any other conditions. For the Two-State Humean, the answer depends on whether the property is part of the the 'M-state' (for which the ordinary Humean's answer applies) or part of the L-state. We will argue that, for the physical ontology which makes up the L-state, the Two-State Humean satisfies the nomic necessitarian intuition. The identity of an element of the L-state is closely dependent on the role it plays in the system of that world. We will argue that this connection is tight enough to capture the nomic necessitarian intuition that these properties have their nomic roles necessarily.[6]

[6]Why go to all this trouble of Two-State Humeanism? A reviewer suggests a much simpler strategy which also seems to generate properties that have their nomic roles essentially, using only the resources of the ordinary BSA. Here's the idea:

Start with a standard Lewisian BSA and imagine that it results in there being some property in the actual world that plays the mass role – specifically, the property mass. But there are other worlds where some other property plays the mass role instead. Say for example, in world w_1 property P plays the mass role, and in w_2 Q plays the mass role and so on. Then we can *define* a new property that is coextensive with mass in the actual world, with P in w_1 with Q in w_2 etc. Call this property E. In effect, what's going on is that we are defining up the property of 'instantiating a property that plays the mass role at your world'. There is a sense in which it might appear that such a property necessarily plays the mass role – the objects that instantiate it always act in a mass-y way.

And of course, we can generalize this move to the charge role, and so on. So we can cook up properties that play those roles necessarily.

This is an ingenious move, but we think that the Humean nomic essentialist shouldn't make use of it. Here is the main concern: This account is built upon assuming a standard Lewisian BSA approach to the laws, and using that to generate the nomic roles. The problem with this is that, on the Lewisian approach, there's a natural property that plays the mass role in the actual world – a natural property that appears in the laws governing mass. The property E is not that property. The property E is in effect the property 'instantiates a natural property that plays the mass role at your world'. That is not the property that is involved in, for example, the Newtonian laws of gravitation. So, we think, property E does not in fact, play the mass role, and so is not suitable for the Humean Nomic Essentialist.

To capture the nomic necessitarian intuition, it suffices to establish **Identity-Role Link**:

> **Identity-Role Link:** Two properties instantiated at possible worlds, w_1 and w_2 respectively, are *the same* just in case they play the same nomic role in those worlds.

Identity-Role Link implies that at *any* possible world where a property, P, is instantiated must be one where P plays the same nomic role as it does at any other world. This implies that P has its nomic role necessarily.

We will argue that we can establish **Identity-Role Link** with respect to the properties which, according to the Two-State Humean, comprise the L-state. This will show that the Two-State Humean can successfully capture the nomic necessitarian intuition about *some* properties. Whether it's a problem that this does not apply to *all* properties accepted by the Two-State Humean, is a question we'll address in the next section.

Here's how the argument will go:

(1) Two L-state properties instantiated at possible worlds, w_1 and w_2 respectively, are the same just in case they are denoted by L-state predicates with the same interpretation.

(2) Two L-state predicates, appearing in the best systems of possible worlds w_1 and w_2 respectively, have the same interpretation just in case they play the same role in their respective best systems.

(3) For two L-state predicates to play the same role in their respective best systems *just is* for the nomic roles of the properties they denote to be the same.

(4) Hence, Two L-state properties instantiated at possible worlds, w_1 and w_2 respectively, are the same just in case they play the same nomic role in those worlds.

And (4) just is **Identity-Role Link** restricted to L-state properties, so the Two-State Humean satisfies the nomic necessitarian intuition with respect to the L-state properties.

However, this argument is not exactly correct. Specifically, premise (3) is false. The role of a predicate in the best system can outrun the nomic role of the property it denotes. We'll carry on with this slightly inaccurate version of the argument for now before discussing how to fix it in section 4.2.

4.1 The Argument

Premise 1:

This premise just comes from the way the Two-State Humean defines the L-state in terms of the best systems apparatus. On the Two-State Humean view M-state properties are fundamental. L-state properties, on the other hand, exist *in virtue of* being denoted by an L-state predicate that's part of the best system. The nature and identity of an L-state property is wholly determined by the interpretation given to the predicate introduced in the best system to refer to them.

And so it just follows that two L-state properties instantiated at possible worlds, w_1 and w_2 respectively, are the same just in case they are denoted by L-state predicates with the same interpretation.

Premise 2:

L-state predicates gain their interpretation via the existence of sentences in the system that link them to other vocabulary. For example, if a system includes the sentence 'All Fs are Gs', where F is a L-state predicate and G means 'has positive charge' then F gains its interpretation in part by its connection to the property of having positive charge. And further, the interpretation of F will depend on what the other sentences in the system says about things with positive charge. If it's a law that all Gs are Hs, for example, then this affects the interpretation of F.

More generally, the interpretation of an L-state predicate, F, is determined by the all axioms of the best system that connect F to other predicates $\{P_1 \dots P_n\}$ and all the axioms that connect the members of $\{P_1 \dots P_n\}$ to other predicates $\{Q_1 \dots Q_n\}$, and so on.

So the interpretation of a predicate is a matter of this web of connections branching out to the rest of the best system. Call the position of a particular L-state predicate in this network of links to other vocabulary in the system the *role* of that predicate in the best system.[7] So, two L-state predicates, appearing in the best systems of possible worlds w_1 and w_2 respectively, have the same interpretation just in case they play the same role in their respective best systems.

Premise 3:

There is a clear intuition behind (iii): on the Two-State Humean approach, just as on the traditional BSA, the laws are defined by the best system procedure – the laws are the axioms of the best system. So it seems like for two predicates to play the same role in the best systems is just for the role of the properties they denote in the laws to be the same – that is, for those properties to have *the same nomic role*.

As we noted, this premise isn't exactly right, but let's assume it for the time being. We'll address how the argument works with its more nuanced replacement later on.

Premises 1, 2, and 3 imply Claim 4:

[7] You might be tempted to think that this boils down to the requirement *whole system* in which the L-state predicates are embedded being the same. While this would be simple, it wouldn't be strictly correct. It's possible that two L-state predicates may play the same role in their respective best systems despite the systems being different, because of (e.g.) some isolated "pocket" of physical phenomena whose laws and systematization doesn't overlap *at all* with the pocket containing those two predicates. Think of the case of the property inertial mass in an ordinary Newtonian world vs. a world that has ordinary Newtonian physics but in which there are also completely epiphenomenal immaterial ghosts (that can neither influence nor be influenced by material things). Insofar as it seems plausible that the *role* of the predicate "has inertial mass of 2kg" in the best system would be unchanged if we added an isolated pocket of laws about immaterial ghosts to our best system, then it cannot be that sameness of role in the best system requires sameness of the entire best system.

Suppose that L_1 and L_2 are L-state properties instantiated at possible worlds, w_1 and w_2, respectively. In order to establish Identity-Role Link with respect to this set of properties it suffices to show that $L_1 = L_2$ if and only if L_1 plays the same nomic role at w_1 as L_2 plays at w_2.

Consider the left to right direction first: Suppose $L_1 = L_2$. It suffices to show that L_1 plays the same nomic role at w_1 as L_2 plays at w_2.

By premise 1, since $L_1 = L_2$ then L_1 and L_2 are denoted by L-state predicates in the best systems of w_1 and W_2 (respectively) with the same interpretation. Call those predicates 'P' and 'Q'.

By premise 2, since 'P' and 'Q' are L-state predicates with the same interpretation, they play the same role in the best systems of w_1 and W_2, respectively. By premise 3, the properties 'P' and 'Q' denote play the same nomic role at those worlds. Since 'P' and 'Q' denote L_1 and L_2, respectively, then L_1 and L_2 play the same nomic role at w_1 and w_2, respectively.

Right to left: Suppose L_1 plays the same nomic role at w_1 as L_2 plays at w_2. It suffices to show that $L_1 = L_2$.

By the definition of the L-state, since L_1 and L_2 are L-state properties, they are denoted by L-state predicates, call those predicates 'P' and 'Q', respectively. By premise 3, since L_1 plays the same nomic role at w_1 as L_2 plays at w_2, then 'P' must play the same role in the best system of w_1 as 'Q' plays in the best system of w_2.

By premise 2, since 'P' and 'Q' are L-state predicates which play the same role in their respective best systems, 'P' and 'Q' have the same interpretation. By premise 1, since 'P' and 'Q' are two L-state predicates with the same interpretation, and 'P' and 'Q' denote L_1 and L_2, respectively, then L_1 and L_2 must be the same property – i.e. $L_1 = L_2$.

Since both directions of the biconditional hold, then it follows that $L_1 = L_2$ if and only if L_1 plays the same nomic role at w_1 as L_2 plays at w_2. This directly implies that, for the Two-State Humean, **Identity-Role Link** is satisfied for L-state properties. That is, for the L-state properties:

> **Identity-Role Link:** Two properties instantiated at possible worlds, w_1 and w_2 respectively, are *the same* just in case they play the same nomic role in those worlds.

And, as we argued at the beginning of this section, satisfying **Identity-Role Link** is sufficient to capture the nomic necessitarian intuition, because it implies that properties have their nomic role necessarily. Since the Two-State Humean satisfies this principle for the class of properties which make up the L-state, then it captures the nomic necessitarian intuition, with respect to those properties.

4.2 A Wrinkle

The above argument is, however, not quite correct. Premise 3 is a bit too strong.

Premise 3 says that: For two L-state predicates to play the same role in their respective best systems *just is* for the nomic roles of the properties they denote to be the same.

However, the best system is not a *purely* nomic entity. It contains non-nomic boundary conditions as well as laws. The best system is, roughly, the deductive closure of statements which best systematize the facts about the mosaic, balancing simplicity and informativeness. Nothing about that systematization requires that it only include *laws*; it may include contingent things, like the precise boundary conditions. In fact, such intuitively contingent boundary conditions seem like they will be required for the system to be informative. A system where the axioms are only the laws of Newtonian mechanics, for example, would not be particularly informative on it's own – it needs the addition of boundary conditions specifying what objects there are, their mass, their velocity, and so on.

So, it's false that for two L-state predicates to play the same role in their respective best systems *just is* for the nomic roles of the properties they denote to be the same. The left hand side implies the right, but not vice versa. Two L-state predicates could play different roles in their respective best systems, but the properties they denote could still play the same *nomic* role, if those differences are restricted to the *non-nomic* parts of the best system.

The natural solution is to distinguish between the genuinely nomic parts of the best system and the non-nomic parts. Then the Two-State Humean could claim that two L-state properties are the same if and only if they are denoted by terms such that the *nomic* elements of the systems in which they are embedded, and their connections to the *nomic* elements of that system, are the same. So premise 3 would be adapted:

Premise 3′ For two L-state predicates to play the same role in the *nomic elements* of their respective best systems *just is* for the nomic roles of the properties they denote to be the same.

This change will percolate outwards to other parts of the argument. Specifically, Premise 2 would need to be changed too in the following way:

Premise 2′ Two L-state predicates, appearing in the best systems of possible worlds w_1 and w_2 respectively, have the same interpretation just in case they play the same role in *the nomic elements of* their respective best systems.

(The italicized text is added to the original formulation of premise 2.)

Earlier we said that the interpretation of a predicate is a matter of it's web of connections branching out to the rest of the best system. But, in light of this issue, the right thing for the Two-State Humean to say is that only *some* of the connections to other elements of the best system will be relevant to an L-state

predicate's interpretation. Whether or not some L-state property at another world is mass depends on what the laws are, not on which particular objects are assigned which masses as part of the initial conditions.

Notice that tweaking our original premises in this way will not interfere with the success of our original argument. It still follows that L-state properties will have their nomic roles necessarily.

But how can the Two-State Humean make the distinction between the nomic and the non-nomic elements of a best system? Luckily, such a distinction has been part of the traditional understanding of the BSA. As we noted, the systems that best balance simplicity and informativeness will typically contain things which are intuitively non-nomic boundary conditions. So when the BSA is used as an account of what the laws are some way of distinguishing the laws and the boundary conditions is required. Lewis (1983, p. 367) distinguishes between the nomic and non-nomic elements of the system syntactically – the laws are the parts of the best system that are universal generalizations, the parts of the system that are not generalizations are treated as non-nomic boundary conditions. Hall (2010) does something more radical, building the distinction between laws and background conditions into the systemization procedure itself. He takes systems to come in two parts – an initial condition hypothesis, and a dynamic hypothesis – these are distinguished via different standards of informativeness applying to the two parts of the system. (This idea is further developed by Hicks (2018), Dorst (2019b) and Jaag and Loew (fort).)[8]

The Two-State Humean can appeal to these kinds of strategies to distinguish the laws from the other elements of the system. Whichever way the defender of the traditional BSA chooses to distinguish the laws from the background conditions, the Two-State Humean can replicate it.

5 Limitations of this Account

We've argued that the Humean can capture the nomic necessitarian intuitions that we discussed in section 1. But it's important to be clear about the limitations of the argument. In particular, it only applies to properties in the L-state.

That is, the Two-State Humean doesn't say that *every* property has its nomic role necessarily, only the L-state properties. The M-state properties – the properties that make up the Humean mosaic – do not.

So, there is some truth to the traditional thought that Humeanism is inconsistent with properties having their nomic role necessarily. Even the Two-State Humean must put *something* in the M-state, or else there's

[8]Sometimes this part of the BSA view goes unnoticed, because certain variants of the BSA, notably the so-called "Mentaculus" approach developed by Loewer (2012a) and Albert (2000) reject splitting the best system into nomic and non-nomic elements. Instead, they claim that all the axioms of the best system count as laws, even those which might intuitively appear to be contingent background conditions. (For example, they take the Past Hypothesis – the claim that at its earliest stages the universe had very low entropy – to be a law.)

nothing for the best system to 'latch on' to. For the Humean, then, not *every* property can have it's nomic role necessarily. In this way the Humean nomic necessitarian view is not as thoroughgoing as traditional nomic necessitarian views.

There is a further issue that follows from this: M-state properties are quiddistic. If property switching is possible between properties in the M-state, then there will be genuinely distinct possible worlds that are qualitatively indistinguishable. Adding the L-state machinery on top doesn't change this epistemic problem.

In such pairs of worlds where M-state properties switch, our view implies exactly what the ordinary Humean view implies about such a case: the laws of those worlds will be different. Just as the laws of the two worlds will be different, so too the L-state properties defined in terms of those laws will be different (because the L-state properties will have different nomic roles, since they feature in different laws).

So, the Two-State Humean has to allow that certain properties are part of the M-state and so not defined by their nomic role. And if switching is possible between these M-state properties then the view faces some of the epistemic issues that face traditional Humeanism.

These seem like limitations of the Two-State Humean view. However, the extent to which these limitations are significant will vary depending on the version of the view we accept. In particular, as we noted in section 3.2, there are a range of possible Two-State Humean views which vary in which properties are part of the L-state and which are part of the M-state. Consequently, these different views vary on which properties have their nomic roles necessarily and whether they allow for property switching.

For example, one extreme position that we mentioned in section 3.2 is 'positions-first' Humeanism, according to which the mosaic consists of nothing but particles occupying positions in space-time. Every other physical property or relation would be derived from this extremely sparse mosaic. On this view there could be a world with rich physical ontology (like the masses and charges of the particles, the distribution of electromagnetic field values, and so on), but those things would be part of the L-state posited by the best systematization of the positions-only mosaic. Such a Humean would admit of very few quiddistic properties – position would be quiddistic, but not mass and charge. So, she would resemble the nomic necessitarian in her claims about the modal profile of most physical properties.

Even for the positions first view, there will be a limit – we can't say that *every* physical property has its nomic role necessarily. But, perhaps, it might not be such a disadvantage that the positions-first Humean says position doesn't have its nomic role necessarily. Do we think that position is the type of property that must have its nomic role necessarily? It's intuitive to claim that nothing can be positively charged if it doesn't repel other things that are positively charged. But things look different with position. Imagine we live in a Newtonian world, then part the nomic role of position is to do with the law of gravitation. Do

we think that if the laws of gravitation were different then there would be no such thing as position? That if gravitation followed an inverse-cube law nothing would be positioned anywhere (but, rather, would be schmositioned)?[9]

And further, notice that positions-first Humeanism doesn't face the epistemic problems that arise from the possibility of property-switching. Even if you think position is a quiddistic property, if there's only *one* quiddistic property, then there is no possible role-switching between distinct quiddities.

So, on the positions-first variant of Two-State Humeanism the limitations that we mentioned don't seem particularly significant – there is no property-switching and position is the only property that doesn't have it's nomic role essentially.[10]

The point here is not necessarily to commit to positions-first Humeanism,[11] but rather to note that Two-State Humeanism opens up a range of possibilities, depending on which properties are in the M-state and which are in the L-state, some of which might be very attractive.

Indeed, a promising upshot of the possibility of a Humean nomic essentialism is that the Humean can meaningfully ask (and answer!) the question of *which* physical properties (if any) should have their nomic role essentially. The traditional Humean says that *all* fundamental physical properties must be quiddistic. The Humean nomic essentialist has far more flexibility here; even if she must admit of quiddistic properties somewhere, she has the ability to choose the nature and extent of the quidditism she admits.

6 Conclusion

We have claimed, contrary to the general consensus, that Humean metaphysics can be made consistent with an approach to properties where properties are deeply tied up with their nomic role – where a property could not have had a nomic role other than the one it actually has. We presented a positive argument that certain Humean accounts of laws of nature and the physical world can satisfy the nomic necessitarian intuitions.

In section 2, we explained the nature of the apparent conflict between the Humean worldview and

[9] This is not obvious, and views can reasonably differ on this. (For example, Esfeld and Deckert (2017) defend a similar sort of view, on which the Humean mosaic merely consists of material bodies and distance relations between them. Darby (2018) objects that Esfeld and Deckert's view might not avoid quidditism in the case of distance, but Esfeld and Deckert disagree.)

[10] One might push it even further, and make this same point for a view which admits of multiple kinds of M-state properties, but only ones that, as a matter of metaphysical necessity, *could not* play any other M-state property's role. This may be for structural reasons, for instance if the M-state properties include only the continuous determinable monadic quantity, mass, and the determinate relation, 'x is equal to or less than one angstrom away from y'.

[11] And, indeed, objections have recently been raised for closely related views (like Esfeld's Super-Humeanism) by, e.g., Matarese (2020).

nomic necessitarianism about properties, and how commitment to quiddistic properties seemed inextricably tied to the core tenets of the Humean position. We then, in section 3, argued for the possibility of a view which satisfied both the nomic necessitarian intuition and the core tenets of the Humean worldview, by arguing that non-fundamental properties are able to sidestep the prohibition on necessary connections between distinct existences.

By the end of section 3, we went beyond the mere possibility of such a view, and sketched out what a Humean nomic necessitarian position might look like. Specifically, we argue that the Two-State Humean picture, first introduced in Bhogal and Perry (2017), admits of a class of properties, the L-state properties, which are non-fundamental and grounded in holistic facts about the mosaic, and are perfect candidate for properties which could be both Humean and have their nomic roles necessarily. In section 4, we argued that L-state properties, according to the Two-State Humean picture, indeed have their nomic roles necessarily. We closed by examining some limitations of the view, and specifically questioned whether nomic necessitarianism about *some*, but not *all* physical properties still satisfies the nomic necessitarian intuition.

6.1 The Essentialist Intuition

So far, we've focused on the nomic necessitarian intuition. But what about the title of the paper? Are there any prospects for a Humean nomic *essentialism*? The nomic essentialist intuition, as we said before, is the idea that to be charge or mass *just is* to play a certain nomic role; that the *essence* of these physical properties and relations is *to play such-and-such nomic role*.[12] We think that the view developed in this paper captures this intuition too. Given what's come earlier – specifically, given that we've established the viability of a genuinely Humean nomic necessitarianism, using the tools of Two-State Humeanism – we can argue for this very quickly.

We've established, already, that L-state properties admitted by the Two-State Humean as part of the best system have their nomic roles necessarily. To capture the nomic essentialist intuition, the *essence* of an L-state property must be its nomic role. Where should we look, then, for the essence of an L-state property?

On the Two-State Humean approach, physical ontology that's part of the L-state is introduced via the addition of a corresponding predicate to the (candidate) best system. And, we've said before, the nature and identity of an L-state property is wholly determined by the interpretation of the L-state predicate introduced in the best system to refer to them. The L-state property is *generated* from the role of the corresponding L-state predicate in the system.

But, when L-state predicates are added to a system, they come in *uninterpreted*; what makes it the

[12] If you are uncomfortable with talk of essences, you can understand this claim as an *identity* thesis, according to which the physical property is identical to a certain disposition to behave. Cf. Shoemaker (1980) and, more recently, Chakravartty (2003).

case that a predicate, 'P', introduced to the best system, denotes a property like positive charge is that the predicate features in certain laws in that system about the behavior of the particles in the mosaic. An L-state property has no nature beyond what the corresponding predicate, 'P', contributes, and L-state predicates have no interpretation beyond what falls out of their role in (the nomic part of) the best system. For the Two-State Humean, even though L-state predicates start off *uninterpreted*, the laws *give* them an interpretation, and so it's the laws that characterize *what* the properties those predicates denote *are*.

It seems, then, that the essential nature of an L-state property is determined by the role the corresponding predicate has in laws that describe the behavior of the objects in the mosaic. It's because 'P' plays the *charge role* in this best system that it's correct to say that the property it denotes is positive charge.

In this way, the Humean nomic essentialist is able to do justice to the essentialist intuition. It can offer a clear, non-metaphorical, picture of what the world must be like for the essence of a property, for 'what it is' to be that property, to be nothing over and above that property's nomic role. In fact, the Humean nomic essentialist can *explain* why the L-state properties have their nomic role essentially – it's due to the way that the L-state properties are generated in a systematization procedure.

There are deep attractions to nomic essentialist and nomic necessitarian views, and, previously, it had been thought the only way to enjoy these attractions was to accept an inflated anti-Humean ontology as the cost of admission. But we've argued that this is wrong. You can capture a nomic essentialist view, though one that isn't *quite* as thoroughgoing as traditional versions, without giving up on a Humean metaphysics.

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