

WHY DEFEND HUMEAN SUPERVENIENCE?¹

Siegfried Jaag & Christian Loew

Penultimate draft. The final version is published in *The Journal of Philosophy*.

Humean Supervenience (HS) is a metaphysical model of the world according to which all truths hold in virtue of nothing but the total spatiotemporal distribution of perfectly natural intrinsic properties. David Lewis and others have worked out many aspects of HS in great detail. A larger motivational question, however, remains unanswered: As Lewis admits, there is strong evidence from fundamental physics that HS is false. What then is the purpose of defending HS? In this paper, we argue that the philosophical merit of HS is largely independent of whether it correctly represents the world's fundamental structure. In particular, we show that insofar as HS is an apt model of the world's higher-level structure, it thereby provides a powerful argument for reductive physicalism and explains otherwise opaque inferential relations. Recent criticism of HS on the grounds that it misrepresents fundamental physical reality is, therefore, beside the point.

David Lewis notes that much of his work can be seen as “a prolonged campaign on behalf of [...] ‘Humean Supervenience.’”² According to Humean Supervenience (HS), the world fundamentally consists of the so-called *Humean mosaic*, i.e., the complete pattern of instantiations of perfectly natural intrinsic properties at spacetime points (or their point-sized occupants) and the spatiotemporal relations between them. All other facts about the world obtain in virtue of the Humean mosaic.³ HS is *Humean* because the instantiations of these fundamental properties are ‘loose’ in the sense that they are

¹ Both authors contributed equally to the paper. For helpful discussion and comments on earlier drafts of this paper, we want to thank Ralf Busse, Andreas Hüttemann, Daniel Nolan, Markus Schrenk, and two anonymous referees for this journal. This work was supported by Deutsche Forschungsgemeinschaft (FOR 2495).

² David Lewis, *Philosophical Papers Vol. II* (Oxford: Oxford University Press, 1986), at p. viii.

³ See, e.g., David Lewis's “Causal Decision Theory,” *Australasian Journal of Philosophy*, LIX, 1 (March 1981): 5–30, at p. 20 and his “Philosophical Papers Vol. II,” *op. cit.*, pp. x–xiv. Its name would suggest that HS is merely a supervenience claim. However, it is plausible that Lewis had something stronger in mind, viz., that everything not just supervenes on but reduces to the Humean mosaic. See David Lewis's “Statements Partly About Observation,” *Philosophical Papers*, XVII, 1 (April 1988): 1–31, at pp. 30–1, fn.15; and Lewis's self-characterization in Steve Pyke, *Philosophers* (London: Zelda Cheatele Press, 1995).

freely recombinable: no property instantiation has any modal implications for its neighborhood.⁴

Lewis's motivations for defending HS, however, remain unclear. He explicitly states that "[m]ost likely, if Humean supervenience is true at all, it is true in more or less the way that present physics would suggest."⁵ At the same time, he does very little to show that present physics supports that the world has the fundamental structure HS posits. First, Lewis acknowledges that HS is inspired by classical physics.⁶ However, our best present physics is not classical and arguably posits features that contradict HS, such as entanglement relations.⁷ And, second, even if HS were consistent with present physics, it still would be unclear why one should defend it. Physics, after all, does not seem to require that the world is fundamentally amodal in the way HS entails. For instance, nothing about physics seems to presuppose that laws of nature need to reduce to more fundamental, non-modal facts.⁸ What purpose does defending HS serve if the world does not in fact have the fundamental structure it postulates?

⁴ See David Lewis, "Ramseyan Humility," in David Braddon-Mitchell and Robert Nola, eds., *Conceptual Analysis and Philosophical Naturalism* (Cambridge: MIT Press, 2009), pp. 203–22, at pp. 208–09. Dealing with fundamental magnitudes requires some amendments of the recombination claim. See Cian Dorr and John Hawthorne, "Naturalness," in Karen Bennett and Dean Zimmerman, eds., *Oxford Studies in Metaphysics Volume 8* (Oxford: Oxford University Press), pp. 3–77.

⁵ Lewis, "Philosophical Papers Vol. II," *op. cit.*, pp. x–xi.

⁶ David Lewis, "Humean supervenience debugged," *Mind*, CIII, 412 (October 1994): 473–90, at p. 474.

⁷ See Tim Maudlin, *The Metaphysics Within Physics* (Oxford: Clarendon Press, 2007), at p. 53. Lewis, "Philosophical Papers Vol. II," *op. cit.*, p. xi half-heartedly addresses the conflict between HS and quantum mechanics by stating that he is "not ready to take lessons in ontology from quantum physics as it now is." However, contemporary theories of quantum mechanics arguably no longer have the features that Lewis found problematic (see Barry Loewer, "Humean Supervenience," *Philosophical Topics*, XXIV, 1 (Spring 1996): 101–27, at p. 104). There is also notably less skepticism about quantum mechanics in Lewis's later work (see David Lewis, "How Many Lives Has Schrödinger's Cat?" *Australasian Journal of Philosophy*, LXXXII, 1 (March 2004): 3–22; cf. Brian Weatherston, "David Lewis," *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition), Edward N. Zalta, ed., URL:

<<https://plato.stanford.edu/archives/win2016/entries/david-lewis/>>). Some philosophers have argued, on Lewis's behalf, that (at least the spirit of) HS can be squared with our best current physics. See, e.g., Harjit Bhogal and Zee Perry, "What the Humean Should Say About Entanglement," *Nous*, LI,1 (March 2017): 74–94; Craig Callender, "One World, one Beable," *Synthese*, CXCL, 10 (October 2015): 3153–77; Barry Loewer's "Humean Supervenience," *op. cit.* and his "Laws and Natural Properties," *Philosophical Topics*, XXXV,1/2 (Spring/Fall 2007): 313–28; and Elizabeth Miller, "Quantum Entanglement, Bohmian Mechanics, and Humean Supervenience," *Australasian Journal of Philosophy*, XCII, 3 (2014): 567–83. This project is laudable, but we will argue that HS is philosophically interesting even if it is incompatible with quantum mechanics.

⁸ Maudlin, "The Metaphysics Within Physics," *op. cit.*, p. 67. Maudlin also defends the stronger claim that scientific practice is inconsistent with Humean reductionism about the nomic. But see Richard Healey, "Review of 'The Metaphysics within Physics,'" *Notre Dame Philosophical Reviews* (2008.02.04), Anastasia F. Gutting, ed., URL: <<https://ndpr.nd.edu/news/the-metaphysics-within-physics/>>; and Marc Lange, "Review: Tim Maudlin: The Metaphysics Within Physics," *Mind*, CXVIII, 469 (January 2009): 197–200. See also Christian Loew and Siegfried Jaag, "Humean Laws and (Nested) Counterfactuals," *The Philosophical Quarterly*, LXX, 278 (January 2020): 93–113 for more discussion.

In this paper, we argue that HS is best understood as a metaphysical model and that its two main purposes can be achieved independently of whether it correctly represents the world's fundamental physical structure. The first purpose is defending reductive physicalism, i.e., the view that all truths about the world obtain in virtue of fundamental physical truths.⁹ The second purpose is modelling otherwise opaque inferential relations that we rely on in scientific and everyday reasoning, such as inferences between nomic and non-nomic facts.¹⁰ Our account shows that HS is a fruitful research program and it also sheds light on Lewis's own motivation for defending the view.

The remainder of the paper has the following structure: In §I, we introduce HS in more detail and argue that it is best understood as a metaphysical model. In §II, we argue that HS, so understood, serves to defend reductive physicalism. In §III, we show that, additionally, HS provides a unified model of otherwise opaque inferential relations. In §IV, we summarize our results.

I. HUMEAN SUPERVENIENCE AS A METAPHYSICAL MODEL

Lewis defended HS by proposing reductions of various phenomena to the Humean basis: For example, everyday objects are identified with mereological sums of the point-

⁹ A number of other authors also argue that Lewis's motivation for defending HS is to support (a version of) physicalism. See Ned Hall, "David Lewis's Metaphysics," *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition), Edward N. Zalta, ed., URL: <https://plato.stanford.edu/archives/win2016/entries/lewis-metaphysics/>; Daniel Nolan, *David Lewis* (Chesham: Acumen, 2005), at pp. 29–31, at p. 30; Wolfgang Schwarz, *David Lewis: Metaphysik und Analyse* (Paderborn: Mentis 2009), at p.112; and Brian Weatherson, "Humean Supervenience," in Barry Loewer and Jonathan Schaffer, eds., *The Blackwell Companion to David Lewis* (Oxford: Blackwell, 2015): 101–15, at p. 109. These authors, however, do not argue in detail how HS can serve this purpose if it is mistaken about the world's fundamental physical structure. Moreover, they do not discuss what we take to be the second purpose of HS.

¹⁰ Helen Beebe and Fraser MacBride, "De Re Modality, Essentialism, and Lewis's Humeanism," in Barry Loewer and Jonathan Schaffer, eds., *The Blackwell Companion to David Lewis* (Oxford: Blackwell, 2015): 220–36 argue that a core aspect of HS, viz., the denial of necessary connections between distinct existences, is motivated by Lewis's commitment to reducing all modality to counterpart relations. Jessica Wilson, "Hume's Dictum and Metaphysical Modality," in Barry Loewer and Jonathan Schaffer, eds., *The Blackwell Companion to David Lewis* (Oxford: Blackwell, 2015), pp. 138–58 similarly argues that Lewis's denial of such necessary connections might be motivated as part of the best account of what metaphysical possibilities there are. Peter Godfrey-Smith, "Theories and Models in Metaphysics," *Harvard Review of Philosophy*, XIV (Fall 2006): 4–19 suggests that the purpose of defending HS is to test the limitations of a philosophical model that analyzes all modal connections, such as causation, laws, and probabilities, in terms of facts about the non-modal Humean mosaic. If we are right, then modal reduction is just one aspect of the larger reductive agenda of HS. Moreover, we will explain why modal reductionism is interesting even if our world does not in fact have the amodal fundamental structure that HS posits.

sized constituents of the Humean mosaic. Laws of nature are the contingent universal generalizations belonging to the best systematization of the Humean mosaic. These best-systems-laws, in turn, determine nomological necessity and possibility and help fix the world's counterfactual structure. Causation is understood in terms of these counterfactuals and informs Lewis's causal account of explanation. Dispositions are accounted for via a counterfactual *cum* causal analysis. Mental states are individuated via their causal roles and identified with the physical states that play these roles. And finally, Lewis advocates dispositional analyses of values and colors. These reductions show how the relevant facts are ultimately true in virtue of facts about the Humean mosaic.

But why defend HS in the first place? One crucial question is whether the above reductions are successful or even promising. Can facts about laws, causation, mentality, etc., be reduced to facts about the Humean mosaic?¹¹ A more basic question is what the purpose of defending these reductions is: Why try to show that a wide range of other truths can be accounted for in terms of the facts that are fundamental according to HS? In other words, why would it even be *interesting* if the various reductions were successful?

It would be one thing if we had good reasons for thinking that the world in fact has the fundamental structure that HS posits. But, as pointed out above, Lewis does little to support the truth of its foundational assumptions. A number of philosophers, therefore, have criticized HS as misguided. Most fervently, Ladyman, Ross and Collier argue that "Lewis's world of 'perfectly natural intrinsic properties of points, or of point-sized occupants of points' seems highly unlikely to be the actual one" and so dismiss HS

¹¹ Some anti-Humeans argue that richer metaphysical posits are needed to account for certain phenomena, such as laws (David Armstrong, *What is a Law of Nature?* (Cambridge: Cambridge University Press, 1983); and Maudlin, "The Metaphysics Within Physics," *op. cit.*), causation (Nancy Cartwright, "Causal Laws and Effective Strategies," *Noûs*, XIII, 4 (November 1979): 419–37), counterfactuals (Marc Lange, *Laws and Lawmakers: Science, Metaphysics, and the Laws of Nature* (Oxford: Oxford University Press, 2009)), dispositions or powers (George Molnar, *Powers: a Study in Metaphysics* (Oxford: Oxford University Press, 2003)), and consciousness (David Chalmers, *The Conscious Mind: In Search of a Fundamental Theory* (New York: Oxford University Press, 1996)). Defending reductive analyses in the style of Lewis, however, is an ongoing enterprise. See Jonathan Cohen and Craig Callender, "A better best system account of lawhood," *Philosophical Studies*, CXLV, 1 (April 2009): 1–34; and Loewer, "Laws and Natural Properties," *op. cit.* for revised best systems accounts of laws. See L.A. Paul and Ned Hall, *Causation: A User's Guide* (Oxford: Oxford University Press, 2013) for an overview of reductive theories of causation. And see David Manley and Ryan Wasserman, "On Linking Dispositions and Conditionals," *Mind* CXVII, 465 (January 2008): 59–84 for a reformed counterfactual analysis of dispositions.

as “pseudo-scientific.”¹² According to this criticism, that HS’s foundational posits are not adequately rooted in contemporary physics undermines the entire project.

This criticism presupposes that HS only has philosophical merit as a true description of the world’s actual metaphysical structure. Lewis, however, says explicitly that his motivation for defending HS is not to establish its truth:

The point of defending Humean Supervenience is not to support reactionary physics, but rather to resist philosophical arguments that there are more things in heaven and earth than physics has dreamt of. Therefore if I defend the *philosophical* tenability of Humean Supervenience, that defence can doubtless be adapted to whatever better supervenience thesis may emerge from better physics.¹³

This passage suggests that Lewis did not intend HS as an accurate description of the world’s actual metaphysical structure. Doing so would be tantamount to defending reactionary physics since contemporary physics arguably posits a different structure.¹⁴ In the following, we will demonstrate how HS can be philosophically fruitful even if its foundational assumptions are false. Lewis names one such purpose in the above quote: defending physicalism against philosophical arguments. We will argue below that there is a second, equally important purpose (see §IV).

We propose to understand HS in terms of model-building. Several philosophers have recently argued that model-building is (and should be) a central aspect of philosophical theorizing.¹⁵ According to Godfrey-Smith: “A model is an imagined or hypothetical structure that we describe and investigate in the hope of using it to understand some more complex, real-world “target” system or domain.”¹⁶ A key feature

¹² James Ladyman, Don Ross, and John Collier, *Every Thing Must Go: Metaphysics Naturalized* (Oxford: Oxford University Press, 2007), at pp. 19–20 and p.17.

¹³ Lewis, “Humean Supervenience Debugged,” *op. cit.*, p. 474, italics in the original.

¹⁴ In fact, it is questionable whether HS can even fully capture Newtonian physics. See Jeremy Butterfield, “Against Pointillisme About Mechanics,” *British Journal for the Philosophy of Science*, LVII, 4 (December 2006): 709–53 for an argument that vectorial magnitudes such as velocities and forces are not intrinsic properties. But see Ralf Busse, “Humean Supervenience, Vectorial Fields, and the Spinning Sphere,” *Dialectica*, LXIII, 4 (December 2009): 449–89; and Weatherson, “Humean Supervenience,” *op. cit.* for different accounts of how vectorial magnitudes can be captured within the HS-framework.

¹⁵ See Godfrey-Smith, “Theories and Models in Metaphysics,” *op. cit.*; L.A. Paul, “Metaphysics as Modeling: The Handmaiden’s Tale,” *Philosophical Studies*, CLX, 1 (August 2012): 1–29; Timothy Williamson, “Abductive Philosophy,” *The Philosophical Forum*, XLVII, 3–4 (September 2016): 263–80; and Timothy Williamson, “Model-Building in Philosophy,” in Russell Blackford and Damien Broderick, eds., *Philosophy’s Future: The Problem of Philosophical Progress* (Oxford: Wiley-Blackwell, 2017): 159–72.

¹⁶ Godfrey-Smith, “Theories and Models in Metaphysics,” *op. cit.*, p. 6.

of models is that they can be useful for understanding a target system despite being mistaken about some of its aspects. In fact, models are often useful partly because they represent a system in an idealized or simplified manner.

According to our take on the view, HS is best understood as a model of the world's higher-level structure. The foundationalist part of HS posits a highly regimented fundamental structure that consists only of point-sized objects, perfectly natural intrinsic properties, and spatiotemporal relations. The various analyses in Lewis's reductive hierarchy are then intended to show that commonsensical, higher-level features of the world, such as colors, mentality, and values, can be accounted for in terms of such a sparse fundamental structure. HS, thus, aims to provide a *Humean model* of these higher-level phenomena. We will say that this model is apt, just in case it provides enough structure to account for all higher-level phenomena. In other words, for the Humean model to be apt, a world whose fundamental structure is exhausted by the Humean mosaic needs to allow for phenomena such as colors, mentality, and values.

The Humean model can be apt with regard to the world's higher-level structure without being true of the world as a whole. As an analogy, consider a Newtonian model of a bridge.¹⁷ This model does not truly represent the bridge since our world is not Newtonian. However, the model may still provide an apt representation of the bridge's approximate macroscopic behavior. So, Newtonian physics allows us to model many macroscopic truths about the actual world even though it is mistaken about the world's fundamental structure. Analogously, even if truths about, e.g., colors and mentality are not really made true by just facts about point-sized bearers of properties and spatiotemporal relations, the latter facts may still be enough to account for these truths. In this case, the Humean model is apt with respect to the world's higher-level structure despite being false of the world as a whole.¹⁸ Whether the Humean model is apt or not is controversial. Our goal in the following is not to settle this question but to show why its aptness, if it were established, would be of philosophical importance. Specifically, we will argue that defending the aptness of HS serves two important philosophical purposes.

¹⁷ Cf. Nolan "David Lewis," *op. cit.*, 30–1.

¹⁸ From this perspective, HS is *pace* Ladyman not 'pseudo-scientific' but has a status similar to what scientists call an *effective theory*, i.e., a theory that captures certain phenomena while explicitly ignoring certain parameters of underlying, more fundamental theories.

II. FIRST PURPOSE: DEFENDING REDUCTIVE PHYSICALISM

The first purpose of HS is clear from the Lewis quote in the previous section: defending *reductive physicalism*. Reductive physicalism, roughly, is the view that the world's total structure is exhausted by its physical structure and, moreover, that many of our common-sense beliefs about the world are true in virtue of this structure. Reductive physicalism contrasts, on the one hand, with eliminative physicalism, which entails that our common-sense conception of the world is radically mistaken; and, on the other hand, it contrasts with anti-physicalism, i.e., the view that part of the world's fundamental structure is non-physical.¹⁹

Philosophical arguments against reductive physicalism question whether phenomena like mentality or values can be located in a purely physical world. If these arguments succeed, then the relevant phenomena either require extra-physical structure or need to be eliminated. The safest way of defending reductive physicalism against these arguments would be to show that our final physics accounts for all commonsensical features. However, we do not know the final true physics and can only speculate what it will look like. So, in the meantime, we need a way of defending reductive physicalism "that should work no matter what physical theory the scientists settle on, or at least should work in a very wide range of cases."²⁰ Establishing the aptness of the Humean model provides such a defense of reductive physicalism.

The aptness of HS supports reductive physicalism because HS can be interpreted as a minimal physical model of the world's higher-level structure: that is, a model whose fundamental posits include only spacetime-points, perfectly natural properties such as mass and charge, and spatiotemporal relations.²¹ Such a model is *physical* because all of its posits are uncontroversially physical. Unlike incorporeal ghosts and souls, spacetime-points, properties like mass and charge, and spatiotemporal relations are paradigmatically physical. This ontology, after all, is part of classical physics, which is arguably our best understood physical theory. No one would think that physicalism is false because there is a spacetime with properties such as determinate masses and charges distributed at its points. In addition, this model is *minimal* because its posits are

¹⁹ Weatherson, "Humean Supervenience," *op. cit.*, pp. 108–09.

²⁰ Weatherson, "Humean Supervenience," *op. cit.*, p. 109.

²¹ HS *per se* is not committed to physicalism since it leaves open whether there are perfectly natural (intrinsic) non-physical properties (see Lewis, "Humean Supervenience Debugged," *op. cit.*, p. 474).

very sparse. If the Humean model is apt, then intrinsic properties of point-sized objects and spatiotemporal relations alone suffice to account for all higher-level phenomena, including colors, mentality, and values. So, a very sparse physical structure would suffice to account for all commonsensical features of the world and, hence, to make true reductive physicalism.

Weatherson discusses one way this defense of reductive physicalism can be relevant even if HS is mistaken about the world's fundamental structure.²² Since the Humean model is so minimal, our final physics most likely will posit more fundamental structure rather than less. For example, the correct lesson from quantum mechanics may be that entanglement relations are metaphysically fundamental *in addition* to intrinsic properties of point-sized objects and spatiotemporal relations. Since the aptness of the Humean model shows that a subset of this structure already suffices to account for all commonsensical features, it follows that these features are also accounted for given this interpretation of quantum mechanics. Specifically, if these commonsensical features can be reduced to the Humean mosaic, then they can also be reduced to any structure that contains the Humean mosaic as a sub-structure.

However, we cannot be sure that the ontology of our final physics will simply be an augmentation of the ontology of classical physics. For example, some Ontic Structural Realists argue that our best current physics suggests that fundamental reality is exhausted by a vast network of relations. In this case, there would be no particles or intrinsic properties at the fundamental level,²³ and so the aptness of the Humean model would not straightforwardly tell us where to locate common-sense features in this physical structure. Similarly, dispositionalists argue that properties at the fundamental level are irreducibly dispositional and so are already modally infused.²⁴ According to these theories, fundamental reality is substantially different from what HS posits.

²² Weatherson, "David Lewis," *op. cit.*

²³ See Steven French, *The Structure of the World: Metaphysics and Representation* (Oxford: Oxford University Press, 2014), and Ladyman *et al.*, "Everything Must Go," *op. cit.*

²⁴ See Alexander Bird, *Nature's Metaphysics: Laws and Properties* (Oxford: Oxford University Press, 2007), Heather Demarest "Powerful Properties, Powerless Laws," in Jonathan Jacobs, ed., *Causal Powers*, (Oxford: Oxford University Press, 2017), pp. 38–53; and John Heil, *From an Ontological Point of View* (Oxford: Clarendon Press, 2003). French "The Structure of the World," *op. cit.*, ch. 10 also argues that the world's fundamental structure is intrinsically modal. See Angelo Cei and Steven French, "Getting Away from Governance: A Structuralist Approach to Laws and Symmetries," *Methodes*, IV (2014): 25–48, at p. 39 for similarities between Ontic Structural Realism and certain versions of dispositionalism.

Nonetheless, the aptness of the Humean model would still give us at least a general strategy for locating common-sense features: First, the Humean model is adaptable to other ontologies. For example, according to Lewis's best systems analysis, laws of nature derive from systematizations of the actual distribution of perfectly natural properties, which he takes to be intrinsic and instantiated by point-sized objects. However, a best systems analysis need not be wedded to this restriction.²⁵ If Ontic Structural Realism is true, then all fundamental properties are relational. A structuralist ontology then still allows a best systems analysis of laws that systematizes the arrangement of fundamental, perfectly natural relations.²⁶ Similarly, Barbara Vetter proposes to combine a dispositionalist metaphysics with a best systems analysis of laws. Although the fundamental properties are intrinsically modal according to this proposal, the laws are still determined by their total distribution.²⁷ The philosophical objections against these best systems analyses of laws are the same no matter the underlying ontology. So, to the extent that the best systems account of laws proves viable in the case of HS, it is equally viable in the structuralist and dispositionalist case.

And, second, even if some analyses that are part of HS have no direct analog given an alternative fundamental ontology, many 'higher-up' analyses work just the same. For example, as seen, structuralist and dispositionalist ontologies might require modifying the preferred Humean analysis of laws of nature. But once we have laws of nature, the aptness of the Humean model provides a straightforward story of how to get from laws to counterfactuals to causation and then all the way up to mentality and values.²⁸ For example, Alexander Bird emphasizes that even if all fundamental properties are irreducibly dispositional, we still need to provide an analysis of non-fundamental dispositions.²⁹ How exactly to adapt the Humean analyses to other fundamental ontologies would have to be worked out case by case. Our point here is

²⁵ See Loewer, "Laws and Natural Properties," *op. cit.*

²⁶ See what French "The Structure of the World," *op. cit.*, ch. 9.2 calls *Humean Structuralism*. French ultimately rejects Humean Structuralism, but this rejection is grounded in metaphysical arguments rather than straightforwardly 'read off' the physics.

²⁷ See Barbara Vetter, *Potentiality: From Dispositions to Modality* (Oxford: Oxford University Press, 2015), at p. 289; cf. also Demarest, "Powerful Properties, Powerless Laws," *op. cit.*

²⁸ Some Humean analyses, such as the analysis of dispositions, presuppose the existence of objects and their intrinsic properties. But even Ontic Structural Realism can make room for them as derivative, non-fundamental entities (see Holger Lyre, "Humean Perspectives on Structural Realism," in Friedrich Stadler, ed., *The Present Situation in the Philosophy of Science* (Dordrecht: Springer, 2019), pp. 381–97).

²⁹ Alexander Bird, "Overpowering: How the Powers Ontology Has Overreached Itself," *Mind*, CXXV, 498 (April 2016): 341–83.

that HS, although it is inspired by classical physics, allows a defense of reductive physicalism that extends to a whole range of other ways final physics might turn out. (One may now wonder what makes the Humean model preferable to, say, dispositional essentialism as a defense of reductive physicalism if both support the same reductive analyses. We will address this question in §III.)

We, thus, have a very good motivation for defending HS regardless of the truth of its foundational assumptions. If we can show that the structure HS posits suffices to account for all commonsensical features of the world (i.e., if the Humean model is apt), then we can be confident that the structure our true physics posits will also account for these features; and so reductive physicalism is true. Viewing the project of HS in this light explains Lewis's bold remark that "if I defend the *philosophical* tenability of Humean Supervenience, that defence can doubtless be adapted to whatever better supervenience thesis may emerge from better physics."³⁰

Interpreting HS as supporting reductive physicalism, however, seems to leave one central aspect of the view unmotivated. HS provides a model of the world according to which all modal facts reduce to non-modal facts. Call this project *Humean reductionism*. Humean reductionism is different from physicalism because the existence of at least some modal phenomena, such as laws or chances, as *sui generis* entities arguably would not contradict physicalism.³¹ So it may seem that defending Humean reductionism is not necessary to defend reductive physicalism. What then is the motivation for defending Humean reductionism as part of HS?

We have two answers to why Humean reductionism is part of HS. Our first answer is that Humean reductionism in fact does strengthen the case for reductive physicalism. It is epistemically possible that the best interpretation of our final physics does not posit any fundamental modal structure. In this case, the truth of reductive physicalism does hinge on whether our common-sense beliefs about causation, mentality, etc., can be true in a fundamentally amodal world. And establishing the aptness of the Humean model would show exactly that, viz., that these beliefs are true regardless of whether our world has any fundamental modal structure.

³⁰ Lewis, "Humean Supervenience Debugged," *op. cit.*, p. 474; italics in the original.

³¹ See Maudlin, "The Metaphysics Within Physics," *op. cit.*, p. 52, and Weatherson, "Humean Supervenience," *op. cit.*, p. 110.

Moreover, even if our best scientific metaphysics does posit fundamental modal structure, it is still debatable what kind of modal structure it is. For example, does our fundamental modal metaphysics comprise potencies (Bird), subjunctive facts (Lange) or *sui generis* laws (Maudlin)?³² Since the aptness of the Humean model shows that our common-sense beliefs are true regardless of whether the world has *any* modal structure, it thereby shows that it does not matter for the truth of reductive physicalism how this debate is resolved.³³ So, establishing the aptness of the Humean model is the ‘safest bet’ if you want to defend reductive physicalism. It maximizes the chances that reductive physicalism is true regardless of the details of our final physics.

Our second answer to the question of why Humean reductionism is part of HS is that defending it serves another important purpose, viz., to provide a unified model of an important class of inferential relations.³⁴ We will turn to this purpose next.

III. SECOND PURPOSE: EXPLAINING INFERENTIAL RELATIONS

Many successful inferences, both in science and everyday life, involve seemingly distinct facts. For example, we can infer from nomic to non-nomic facts, from causes to counterfactuals, and from the mental to the physical. These inferences are in need of explanation. How are the relevant facts related such that one can infer from one kind of fact to another? Moreover, the need to explain these inferences arises regardless of one’s metaphysics of the relevant phenomena. For example, both reductionists and non-reductionists about mental states need to explain why there are important inferential relations between mental and physical facts.

Lewis’s interest in this issue is clear from his criticism of Armstrong’s anti-Humean account of laws of nature.³⁵ There are tight inferential relations between nomic

³² See Bird, “Nature’s Metaphysics,” *op. cit.*; Lange, “Laws and Lawmakers,” *op. cit.*; and Maudlin, “The Metaphysics Within Physics,” *op. cit.*

³³ Arguably, if the world indeed has some fundamental modal structure, then at least some Humean analyses of modal phenomena would be redundant or even misplaced. That may be so. But our point here is merely that even in this case the Humean model, if it is apt, would show that fundamental modal structure is not *needed* to account for our common-sense conception of the world.

³⁴ Weatherson, “Humean Supervenience,” *op. cit.*, pp. 110–12 argues that Humean reductionism is motivated by Lewis’s prior commitment to descriptivism about modal concepts. We think that there is some evidence for this interpretation. But we will argue that the amodal nature of HS’s fundamental posits also has an independent philosophical motivation.

³⁵ See Armstrong, “What is a Law of Nature,” *op. cit.* See also Fred Dretske, “Laws of Nature,” *Philosophy of Science*, XLIV, 2 (June 1966): 248–68; and Michael Tooley, “The Nature of Laws,” *Canadian Journal of Philosophy*, VII, 4 (December 1977): 667–98 for similar accounts of laws.

and non-nomic facts. For example, *it is a law that p* entails that p . Moreover, if it is a law that *all F s are G s*, then we can infer from an object's being an F that it is also a G . An adequate theory of lawhood should explain these inferences. Why can we infer from nomic to non-nomic facts? And what is it about laws that enables inferences from one fact to a distinct fact, from an object's being an F to its being a G ?

Armstrong holds that laws of nature obtain in virtue of the instantiations of an irreducible 'lawmaking' second-order relation. According to Armstrong, it is a law that all F s are G s just in case F and G instantiate the (second-order) necessitation relation N . The law that all F s are G s is identified with the 'singular' (second-order) state of affairs $N(F,G)$, which is irreducible to the universally quantified truth that all F s are G s.³⁶ This additional nomic structure contradicts HS, which limits the world's inventory of fundamental entities to intrinsic properties of point-sized objects and spatiotemporal relations. Lewis's main worry about Armstrong's theory of laws, however, is not about metaphysical parsimony.

Lewis objects against Armstrong's theory that it obscures the above mentioned inferential relations. It leaves unexplained, for example, why the law $N(F,G)$ together with Fa licenses the inference to Ga :

Whatever N may be, I cannot see how it could be absolutely impossible to have $N(F,G)$ and Fa without Ga . (Unless N just is constant conjunction, or constant conjunction plus something else, in which case Armstrong's theory turns into a form of the regularity theory he rejects.)³⁷

By construing the law $N(F,G)$ as a metaphysically distinct entity that is not reducible to the generalization *that all F s are G s* (or the corresponding constant conjunction), Armstrong leaves it mysterious how the law, so understood, underwrites the inference from Fa to Ga .³⁸ To account for the inference, Armstrong would have to assume an unexplained metaphysical connection between $N(F,G)$ and the regularity that all F s are

³⁶ The second-order state of affairs $N(F,G)$, according to Armstrong, "What is a Law of Nature," *op. cit.*, p. 90 is also a first-order universal that is instantiated by first-order states of affairs such as Fa and Ga . But although $N(F,G)$ may thus not be wholly distinct from its instances, it nonetheless cannot be reduced (see David Lewis, "New work for a theory of universals," *Australasian Journal of Philosophy*, LXI, 4 (December 1983): 343–77, at p. 366).

³⁷ Lewis, "New work for a theory of universals," *op. cit.*, p. 366.

³⁸ Bas van Fraassen, *Laws and Symmetry* (Oxford: Oxford University Press, 1989), at p. 64 has dubbed this objection against Armstrong's theory the "inference problem."

Gs. Lewis, thus, claims that “there is no point believing in them [Armstrong-laws], because they would be unfit for their work.”³⁹

Lewis’s own account of laws, by contrast, straightforwardly explains why laws license inferences to non-nomic facts. According to Lewis’s best systems account, the law that all *Fs* are *Gs* consists in the fact that the generalization that all *Fs* are *Gs* is among those true generalizations that belong to the best (i.e., simplest and strongest) systematizations of the Humean mosaic. It is then obvious both why the fact that it is a law that all *Fs* are *Gs* entails that all *Fs* are *Gs* and also why the law that all *Fs* are *Gs* licenses the inference from *Fa* to *Ga*. The law that all *Fs* are *Gs* just is the corresponding generalization. So, Lewis’s reductive account of laws of nature provides a clear model of how there can be inferential relations between seemingly distinct facts. On this account, it is utterly unmysterious why the relevant inferences go through. In fact, the question arises: “How else could the logical implication obtain?”⁴⁰

We argue that the second purpose of HS is showing how otherwise opaque inferences can be explained via metaphysical reductions. Laws of nature are only one instance where we can infer from one type of facts (nomic facts) to a different type of facts (non-nomic facts). We can also infer, for example, from causal facts to counterfactuals (e.g., from the fact that *x* causes *y* to the fact that if *x* had not occurred, *y* would not have occurred), from dispositional facts to counterfactuals (e.g., from the fact that if something *o* is disposed to exhibit response *r* in conditions *c* to the fact that if *o* were in *c*, it would exhibit *r*), and from mental facts to physical dispositional facts (e.g. from the fact that subject *s* is in pain to the fact that *s* is disposed to whim). The exact nature of these inferences can be debated, but it is uncontroversial that there are important inferential connections between these different kinds of facts. For example, Elizabeth Prior observes that it is “pre-theoretic common ground” that there is a conceptual connection between dispositions and counterfactuals.⁴¹

Some inferences are uncontroversially explained by reductive relations. For example, we can infer the mass of a whole from the masses of its non-overlapping

³⁹ Lewis, “Philosophical Papers Vol. II,” *op. cit.*, p. xii.

⁴⁰ Loewer, “Humean Supervenience,” *op. cit.*, p. 113. We are not claiming here that Lewis’s account of laws comes without problems. For instance, anti-reductionists about laws have worried that Humean reductionism deprives the laws of their explanatory power.

⁴¹ Elizabeth Prior, *Dispositions* (Aberdeen: Aberdeen University Press, 1985), at p. 5.

parts;⁴² or, we can infer that a whole is fully located within a certain spacetime region from the fact all of its parts are wholly located within that region. It is extremely plausible that these inferences hold because the properties of wholes reduce to the properties of their parts. Lewis was keenly aware of the explanatory nature of these reductions. He argued that construing fusions as “nothing over and above” their parts explains what would otherwise be a “highly mysterious necessary connection between distinct existences.”⁴³

HS, according to our interpretation, provides a radical metaphysical model according to which *all* inferential relations between seemingly distinct kinds of facts are ultimately explained by reductions. HS starts from a bottom layer of categorical, non-modal facts that are freely recombinable. There are no inferential relations between these facts whatsoever. Lewis then argues that all other facts reduce to these bottom-layer facts. There is a reductive hierarchy from the Humean mosaic all the way ‘up to’ normative facts (see §I). This reductive hierarchy explains why there are inferences between the so-related facts. If this model of inferential connections works, it has huge philosophical import because it allows us to apply a simple and well-understood model of inferential connections across the board.

Lewis does not provide a general account of reduction, but, instead, “offers an assortment of distinctive approaches for constructing such reductions, of which there are many examples but no single, canonical exposition.”⁴⁴ Paradigmatic examples of reductive relations are identity and composition, which according to Lewis are close relatives.⁴⁵ We have already seen one example of a Lewisian reduction above: the reduction of laws to regularities. In the following, we will examine two further examples and illustrate how they explain inferential relations.

⁴² Karen Bennett, “‘Perfectly Understood, Unproblematic, and Certain’ – Lewis on Mereology,” in Barry Loewer and Jonathan Schaffer, eds., *The Blackwell Companion to David Lewis* (Oxford: Blackwell, 2015), pp. 250–61, at p. 257 calls this Lewisian principle *property inheritance*.

⁴³ See David Lewis, *Parts of Classes* (Oxford: Blackwell, 1991), at p. 81 and p. 86.

⁴⁴ Hall, “David Lewis’s Metaphysics,” *op. cit.*

⁴⁵ See Lewis, “Parts of Classes,” *op. cit.*, ch. 3.6. We are agnostic whether other relations are also candidates for reductive relations. For instance, although Lewis himself did not state his views this way, some philosophers including Gideon Rosen, “Metaphysical Dependence: Grounding and Reduction,” in Bob Hale and Aviv Hoffman, eds., *Modality: Metaphysics, Logic, and Epistemology* (Oxford: Oxford University Press, 2010), pp. 109–36 have suggested that reductions can be understood in terms of grounding. But see Paul Audi, “Grounding: Toward a Theory of the In-Virtue-Of Relation,” *Journal of Philosophy*, CIX, 12 (December 2012): 685–711. See also the discussion in Elizabeth Miller, “Humean Scientific Explanation,” *Philosophical Studies*, CLXXII, 5 (May 2015): 1311–32.

Our first example is Lewis's account of dispositions. Lewis analyzes dispositions in terms of counterfactuals. Here is the "unlovely mouthful":

Something x is disposed at time t to give response r to stimulus s iff, for some intrinsic property B that x has at t and for some time t' after t , if x were to undergo stimulus s at time t and retain property B until time t' , s and x 's having of B would jointly be an x -complete cause of x 's giving response r .⁴⁶

This analysis specifies what it is to have a disposition in counterfactual terms and thereby encodes what counterfactuals we can infer from an object having a disposition. Consider a cup's disposition to break if dropped. According to the above analysis, the cup has this disposition, just in case it has an intrinsic property B (perhaps its molecular structure) such that if the cup were dropped and retained B until some time after the dropping, the dropping and the cup's having B would cause its breaking.⁴⁷ It is controversial whether this analysis is adequate.⁴⁸ But whatever inferences to counterfactuals the true analysis of dispositions encodes, Lewis's account illustrates how these inferences can be explained via reduction.

Lewis offers two different strategies for an ontological reduction of dispositions. The first strategy identifies the disposition with the (intrinsic) causal base property B directly. The second strategy identifies the disposition with the 'role property' of having some intrinsic property that plays the causal-*cum*-counterfactual role that B in fact plays. So, the question is whether to identify the disposition with the occupant of the role or the role property itself.⁴⁹ Either identification, however, would explain the inference from the having of the disposition to the truth of the counterfactual on the right side of the analysis. In the first case, the disposition is identical to a property that

⁴⁶ David Lewis, "Finkish Dispositions," *Philosophical Quarterly*, XLVII, 187 (April 1997): 143–58, at p. 157.

⁴⁷ We are simplifying a bit here. More precisely, Lewis's analysis entails that the intrinsic property B of the cup together with the dropping would be an x -complete cause of its breaking, where " x " in this example stands for the cup. An " x -complete cause" is "a cause complete in so far as havings of properties intrinsic to x are concerned, though perhaps omitting some events extrinsic to x " (Lewis, "Finkish Dispositions," *op. cit.*, p. 156).

⁴⁸ See, e.g., Alexander Bird, "Dispositions and Antidotes," *The Philosophical Quarterly*, XLVIII, 191 (April 1998): 227–34; and Sugho Choi, "The Simple vs. the Reformed Analysis of Dispositions," *Synthese*, CXLVIII (January 2006): 369–79.

⁴⁹ Lewis favors this second strategy for dispositions (see Lewis, "Finkish Dispositions," *op. cit.*, p. 152). But, interestingly, when he faces a similar choice with respect to the reduction of the mental to the physical, he favors the first strategy (see David Lewis, "Reduction of mind," in Samuel Guttenplan, ed., *A companion to the philosophy of mind* (Oxford: Blackwell, 1994), pp. 412–31).

in fact plays a certain causal-*cum*-counterfactual role, and so the instantiation of this property guarantees the truth of the relevant counterfactual because it is constitutive of the role. In the second case, where the disposition is identified with the property of having a property that plays the causal-*cum*-counterfactual role, it is metaphysically necessary that when the disposition is instantiated the counterfactuals that are part of that role are true. So, either Lewisian reduction explains the inference from dispositions to counterfactuals.

Our second example is Lewis's reduction of causation to counterfactuals. Lewis analyzes causation in terms of counterfactuals: an event *c* causes a distinct event *e*, just in case certain counterfactuals involving *c* and *e* are true.⁵⁰ Causation, however, is disanalogous to dispositions in the following respect: The analysis of dispositions specifies a role such that dispositions can be identified with either the role-property or its occupant. But Lewis argues that with regard to causation not every true causal statement corresponds to a relation. Causation, for Lewis, cannot be a relation because absences can be causes although they cannot stand in relations. Nonetheless, Lewis maintains that causation "is somehow a matter of counterfactual dependence of events (or absences) on other events (or absences)."⁵¹ Lewis's strategy here, arguably, is to directly identify causal facts with counterfactual facts. This identification then explains why the corresponding inferences obtain. In general, the aptness of the Humean model shows that we can fully explain inferential relations between seemingly distinct entities without positing any primitive modal connections.

Reduction is not the only possible explanation of these inferential relations. Non-reductionists may posit these relations as primitive. For example, Jonathan Schaffer has recently argued that non-reductive theories of lawhood, such as Armstrong's theory, may regard the inference from laws to the corresponding regularities as an axiom of their law-theory. Or, dualists like David Chalmers may argue that inferences from mental to physical facts are underwritten by fundamental psycho-physical bridge-

⁵⁰ See David Lewis, "Causation," *Journal of Philosophy*, LXX, 17 (October 1973): 556–67 and David Lewis, "Causation as Influence," *Journal of Philosophy*, XCVII, 4 (April 2004): 182–97 for different counterfactual accounts of causation.

⁵¹ David Lewis, "Void and Object," in John Collins, Ned Hall, and L.A. Paul, eds., *Causation and Counterfactuals* (Cambridge: MIT Press, 2004), pp. 277–90, at p. 287.

laws.⁵² Positing these axioms or bridge-laws, however, comes as an additional cost for non-reductive theories. Reduction, by contrast, explains inferential connections in a simpler and more unified way. According to HS, *all* inferential relations between seemingly distinct phenomena are explained as part of a single reductive hierarchy.

The Humean model of explaining inferences via reduction is interesting even if HS turns out to be false. HS takes as its starting point the ontology of classical physics, which is relatively well-understood and does not contain any necessary connections among its fundamental posits. The aptness of the Humean model demonstrates that this basic ontology suffices to support reductive explanations of all inferential relations between seemingly distinct facts, such as nomic, causal and counterfactual facts.

Now, the world's true fundamental ontology may turn out very different from what HS posits. However, that the relevant reductions can be carried out with the sparse ontology inspired by classical physics shows that it can most likely be carried out with *any* ontology. For example, as pointed out in §II, the Humean reductions would still apply if the world's fundamental structure were dispositional, and so it could then still be used to explain inferential relations between, say, the fundamental dispositional properties and laws. So, even in this case we would not have to posit primitive inferential relations between the world's fundamental properties and the laws of nature. The aptness of the Humean model gives us a general blueprint for explaining inferential relations without adding additional posits to our theory. This blueprint applies to many different ways the world's fundamental ontology could turn out.

But what makes HS preferable over other reductive programs? In this and the previous section, we have argued that the reductions that are part of HS can be adapted to other ontologies, such as dispositional essentialism. This adaptability is part of our explanation for why defending HS is interesting even if it is mistaken about the world's actual fundamental metaphysical structure. However, it also creates a challenge. We have argued that the main benefit of defending HS is that it provides recipes for reducing facts like laws, causation, colors, and values to the world's basic ontology. And we have also argued that these reductions are still applicable if fundamental ontology turns out to be different from what HS posits. So, why then defend HS rather than some

⁵² See Jonathan Schaffer, "It is the Business of Laws to Govern," *Dialectica*, LXX, 4 (December 2016): 577–88; and David Chalmers, *The Conscious Mind: In Search of a Fundamental Theory* (New York: Oxford University Press, 1996), at p. 112.

other reductive program with a different fundamental ontology? What makes HS preferable to these programs?

To answer this challenge, we need to look more closely at competing reductive programs. We will focus on dispositional essentialism and the reduction of laws of nature. Dispositional essentialists hold that fundamental properties are essentially dispositional or powerful and, hence, that some modal facts are metaphysically basic. They have two main options for reducing laws of nature: The first option is to endorse the same account as Humeans, for example by adopting a best systems account of laws.⁵³ Dispositional essentialists can then explain inferential relations between laws of nature and their instances by pointing out that laws are merely regularities in the distribution of powerful properties. And they could explain other inferential relations by copying (or adapting) other Humean reductions.

This option, however, is a lot better suited to Humeanism than to dispositionalism or other anti-Humean ontologies. According to the best systems account (and other Humean-friendly accounts), laws of nature do not arise from the intrinsic nature of the fundamental posits but from the pattern of their distribution in spacetime. So, if dispositional essentialists endorse a best systems account of laws and also follow the Humean recipe for reducing other higher-level modal facts, the dispositional natures they posit would do no work in explaining other modalities, such as laws, counterfactuals, and higher-level dispositions. By contrast, defending the same reductions with a Humean ontology avoids commitment to arguably mysterious “anti-Humean whatnots,” such as dispositional essences, that play no explanatory role.⁵⁴ And the same point applies, *mutatis mutandis*, to other anti-Humean ontologies that adopt the Humean reductive strategy. So, if we just want to illustrate the aptness of the Humean analysis, Humeanism is a better fit than other ontologies.

The second option for dispositional essentialists is to maintain that dispositional natures are relevant for reductive explanations of higher-level phenomena. Dispositional essentialists then have to offer different reductions than Humeans of at least some phenomena. For example, Bird who developed the most worked-out

⁵³ See Vetter, “Potentiality,” *op. cit.*, p. 289 for discussion.

⁵⁴ Dispositionalists sympathetic to a best systems account of laws, such as Demarest “Powerful Properties, Powerless Laws,” *op. cit.*; and Vetter, “Potentiality,” *op. cit.*, may insist that they are in a better position than Humeans when it comes to explaining why the pattern of property instantiations is the way it is in the first place. This, however, is contested by Humeans (see Loewer “Humean Supervenience,” *op. cit.*).

dispositional account of laws of nature, argues that “laws are those regularities whose truth is guaranteed by the essentially dispositional nature of one or more of the constituent properties.”⁵⁵ According to this account, dispositional natures do genuine work in explaining the laws of nature. For instance, that objects with opposite charges repel each other is a law because it somehow follows from the dispositional nature of charge that charged objects would manifest this behavior if they were in suitable circumstances.

This option, however, is inferior to the Humean model, at least for the purposes of defending reductive physicalism and providing a transparent account of inferential relations. First, though we do not have space to discuss Bird’s or other anti-Humean accounts of laws in detail, there is at least a suspicion that they lack the transparency of the Humean story. For example, Bird’s account seems to lack any deeper explanation of what it is exactly about the (higher-order) dispositional nature of, say, charge that makes it that certain (first-order) regularities, such as that like charges repel, are true. So, a similar inference problem that besets Armstrong’s view of laws also seems to affect dispositional essentialism.⁵⁶ If this is true, then dispositional essentialists either cannot explain the inferential connection between laws and their instances at all, or only by building it into their account as a further primitive posit.

Second, and more importantly, these alternative reductions lack the flexibility that makes the Humean story adaptable to a wide range of ways the fundamental structure of our universe might turn out. As we have seen, dispositional essentialists only avoid making their primitive posits explanatorily redundant by insisting that the nature of these posits is essential for at least some reductions of higher-level phenomena. But if the exact nature of the fundamental posits is essential to the explanation, we can no longer use the relevant reductions should our best interpretation of future physics reveal that fundamental reality does not in fact contain them. So, if we want our defense of reductive physicalism and explanation of inferential

⁵⁵ Bird, “Nature’s Metaphysics,” *op. cit.*, pp. 46–7.

⁵⁶ For discussion see Barker and Smart, “The Ultimate Argument Against Dispositional Monist Accounts of Laws,” *op. cit.*; Siegfried Jaag, “Dispositional Essentialism and the Grounding of Natural Modality,” *Philosophers’ Imprint*, XIV, 34 (December 2014): 1–21; and Matt Tugby, “Rescuing Dispositionalism From the Ultimate Problem: Reply to Barker and Smart,” *Analysis*, LXXII, 4 (October 2012): 723–31. See Siegfried Jaag, *Explaining Laws of Nature* (unpublished Dissertation) for an extensive discussion of the inference problem, including versions affecting Lange’s subjunctive primitivism and Maudlin’s primitivism about laws.

relations to apply largely independent of what our world is really like fundamentally, HS is preferable to the most obvious alternatives. In sum, understanding HS as a model of inferential relations nicely explains both why modal reductionism is part of the Humean project and why HS is worth defending even if it is mistaken about the world's fundamental structure.

Viewing HS in this way also indicates where this model is stretched to its limits. The Humean model runs into trouble in domains where the relation between the respective facts is less tight than one would expect if one were reducible to the other. One such domain is chance. According to HS, facts about chances need to ultimately reduce to facts about the distribution of non-modal properties, specifically relatively frequencies. However, chances and frequencies can come significantly apart: many different frequencies are compatible with any given chance distribution.⁵⁷ The question is then whether the relative 'looseness' of this relation is still compatible with facts about chances being reducible to facts about frequencies. So, it comes as no surprise that Lewis was worried about chance: "There is one big bad bug: chance. It is here, and here alone, that I fear defeat."⁵⁸ Defending Humean theories of chance is an ongoing effort and it is beyond the scope of this paper to assess whether the Humean model is apt with respect to chance. We only want to note that if we are right that HS is meant to explain inferential relationships, it is to be expected that challenges arise in the case of chance.⁵⁹

IV. CONCLUSION

We have argued that HS is best understood as a metaphysical model. So understood, HS serves two important philosophical purposes: defending reductive physicalism and explaining otherwise opaque inferential relations. We have also shown how HS can

⁵⁷ See Weatherson, "Humean Supervenience," *op. cit.*

⁵⁸ Lewis, "Philosophical Papers Vol. II," *op. cit.*, p. xiv. See also Ned Hall, "Correcting the Guide to Objective Chance," *Mind*, CIII, 412 (October 1994): 505–18; and Lewis, "Humean supervenience debugged," *op. cit.*

⁵⁹ However, reducing chances to frequencies, arguably, gives Humeans an advantage when it comes to explaining the *Principal Principle* or one of its descendants. These principles say, very roughly, that if you know the objective chance of an outcome, your credence in the outcome should be equal to the chance. Lewis, in "Humean supervenience debugged," *op. cit.*, p. 484, argues that one can "see, dimly but well enough, how knowledge of frequencies and symmetries and best systems could constrain rational credence." By contrast, it is less clear why there is such a connection if chances are *sui generis* metaphysical entities.

serve these purposes even if it is mistaken about the world's fundamental physical structure. In fact, our account explains why, in light of these purposes, it makes sense to base HS on classical physics rather than more contemporary theories. Thus, far from succumbing to neo-scholastic pseudo-science, HS employs an established scientific practice, viz., modelling, in fruitful metaphysical arguments.

SIEGFRIED JAAG & CHRISTIAN LOEW

Heinrich Heine Universität Düsseldorf

Umeå Universitet

References

- Albert, D. Z. (1992). *Quantum Mechanics and Experience*. Cambridge, MA: Harvard University Press.
- Armstrong, D. M. (1983). *What is a Law of Nature?* Cambridge: Cambridge University Press.
- Audi, P. (2012). Grounding: Toward a Theory of the In-Virtue-Of Relation. *Journal of Philosophy*, 109, 685–711.
- Barker, S., & Smart, B. (2012). The ultimate argument against dispositional monist accounts of laws. *Analysis*, 72(4), 714–722.
- Bennett, K. (2015). “Perfectly Understood, Unproblematic, and Certain” – Lewis on Mereology. In B. Loewer & J. Schaffer (eds.), *The Blackwell Companion to David Lewis*, 250–261. Oxford: Blackwell.
- Bird, A. (1998). Dispositions and Antidotes. *The Philosophical Quarterly*, 48, 227–234.
- Bird, A. (2007). *Nature's Metaphysics: Laws and Properties*. Oxford: Oxford University Press.
- Bhagal, H., and Perry Z. (2017). What the Humean Should Say About Entanglement. *Nous*, 51(1): 74–94.
- Busse, R. (2009). Humean Supervenience, Vectorial Fields, and the Spinning Sphere. *Dialectica*, 63(4), 449–489.
- Butterfield, J. (2006). Against Pointillisme About Mechanics. *British Journal for the Philosophy of Science*, 57(4), 709–753.
- Callender, C. (2015). One World, one Beable. *Synthese*, 192(10), 3153–3177.
- Cartwright, N. (1979). Causal Laws and Effective Strategies. *Noûs*, 13(4), 419–437.
- Cei A. and French, S. (2014). Getting Away from Governance: A Structuralist Approach to Laws and Symmetries. *Methodes*, 4 25–48.
- Chalmers, D. J. (1996). *The conscious mind: In search of a fundamental theory*. New York: Oxford University Press.
- Choi, S. (2006). The simple vs. the reformed analysis of dispositions. *Synthese*, 148, 369–379.
- Cohen, J. & Callender, C. (2009). A better best system account of lawhood. *Philosophical Studies*, 145(1), 1–34.

- Dorr, C., & Hawthorne, J. (2013). Naturalness. In K. Bennett & D. Zimmerman (eds.), *Oxford Studies in Metaphysics, Volume 8*, 3–77. Oxford: Oxford University Press.
- Dretske, F. I. (1977). Laws of Nature. *Philosophy of Science*, 44(2), 248–268.
- French, S. (2014). *The Structure of the World: Metaphysics and Representation*. Oxford: Oxford University Press.
- French, S. & Ladyman, J. (2011). In defence of Ontic Structural Realism. In A. Bokulich & P. Bokulich (eds.), *Scientific Structuralism*, 25–42. Dordrecht: Springer.
- Godfrey-Smith, P. (2006). Theories and models in metaphysics. *Harvard Review of Philosophy*, 14(2006), 4–19.
- Hall, N. (manuscript). Humean reductionism about laws of nature. Unpublished Manuscript.
<http://philpapers.org/go.pl?id=HALHRA&proxyId=&u=http%3A%2F%2Fphilpapers.org%2Farchive%2FHALHRA.pdf>
- Hall, N. (1994). Correcting the Guide to Objective Chance. *Mind*, 103, 505–518.
- Hall, N. (2016). David Lewis’s Metaphysics. In E. N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition). Retrieved from:
<https://plato.stanford.edu/archives/win2016/entries/lewis-metaphysics/>
- Hall, N. (2015). Humean reductionism about laws of nature. In B. Loewer & J. Schaffer (eds.), *The Blackwell Companion to David Lewis*, 262–277. Oxford: Blackwell.
- Healey, R. (2008). Review of “The Metaphysics within Physics”. *Notre Dame Philosophical Reviews*. 2008.02.04.<https://ndpr.nd.edu/news/23334-the-metaphysics-within-physics/>
- Heil, J. (2003) *From an Ontological Point of View*. Oxford: Clarendon Press.
- Lange, M. (2009a). *Laws and Lawmakers: Science, Metaphysics, and the Laws of Nature*. Oxford: Oxford University Press.
- Lange, M. (2009b). Review: Tim Maudlin: The Metaphysics Within Physics. *Mind*, 118(469), 197–200.
- Ladyman, J., Ross, D., and Collier, J. (2007). *Every Thing Must Go: Metaphysics Naturalized*. Oxford: Oxford University Press.
- Lewis, D. K. (1966). An argument for the identity theory. *Journal of Philosophy*, 63, 17–25.
- Lewis, D. K. (1973a). *Counterfactuals*. Oxford: Blackwell.
- Lewis, D. K. (1973b). Causation. *Journal of Philosophy*, 70(17), 556–567.
- Lewis, D. K. (1979). Counterfactual Dependence and Time’s Arrow. *Noûs*, 13(4), 455–476.
- Lewis, D. K. (1981). Causal Decision Theory. *Australasian Journal of Philosophy*, 59(1), 5–30.
- Lewis, D. K. (1983). New work for a theory of universals. *Australasian Journal of Philosophy*, 61, 343–377.
- Lewis, D. K. (1986a). *Philosophical Papers Vol. II*. Oxford University Press.
- Lewis, D. K. (1986b). On the plurality of worlds. Oxford: Basil Blackwell.
- Lewis, D. K. (1986c). Causal Explanation. In D. Lewis (ed.), *Philosophical Papers Vol. II*, 214–240. Oxford: Oxford University Press.
- Lewis, D. K. (1988). Statements Partly About Observation. *Philosophical Papers*, 17(1), 1–31.
- Lewis, D. K. (1989). Dispositional theories of value. *Proceedings of the Aristotelian Society*, Suppl. Vol. 63, 113–37.
- Lewis, D. K. (1994a). Humean supervenience debugged. *Mind*, 103(412), 473–490.
- Lewis, D. K. (1994b). Reduction of mind. In S. Guttenplan (ed.), *A companion to the philosophy of mind*, 412–431. Oxford: Basil Blackwell.
- Lewis, D. K. (1997a). Finkish dispositions. *Philosophical Quarterly*, 47, 143–58.

- Lewis, D. K. (1997b). Naming the colours. *Australasian Journal of Philosophy*, 75, 325–42.
- Lewis, D. K. (2004a). How many lives has Schrödinger's cat? *Australasian Journal of Philosophy*, 82, 3–22.
- Lewis, D. K. (2004b). Causation as Influence. In J. Collins, N. Hall, and L.A. Paul (eds.), *Causation and Counterfactuals*, 75–106. Cambridge: MIT Press.
- Lewis, D. K. (2004c). Void and Object. In J. Collins, N. Hall, and L.A. Paul (eds.), *Causation and Counterfactuals*, 277–290. Cambridge: MIT Press.
- Loewer, B. (1996). Humean Supervenience. *Philosophical Topics*, 24(1), 101–127.
- Loewer, B. (2007). Laws and Natural Properties. *Philosophical Topics*, 35(1/2), 313–328.
- Lyre, H. (2010). Humean Perspectives on Structural Realism. In F. Stadler (ed.), *The Present Situation in the Philosophy of Science*. Dordrecht: Springer: 381–397.
- Manley, D. and Wasserman, R. (2008). On Linking Dispositions and Conditionals. *Mind* 117, 59–84.
- Maudlin, T. (2007). *The Metaphysics Within Physics*. Oxford: Clarendon Press.
- Molnar, G. (2003). *Powers: a Study in Metaphysics*. Oxford: Oxford University Press.
- Nolan, D. (2005). *David Lewis*. Chesham: Acumen.
- North, J. (2013). The structure of the quantum world. In A. Ney & D. Z. Albert (eds.), *The Wave Function: Essays on the Metaphysics of Quantum Mechanics*, 184–202. Oxford: Oxford University Press.
- Paul, L. A. (2012). Metaphysics as modeling: the handmaiden's tale. *Philosophical Studies*, 160(1), 1–29.
- Paul, L. A., and Hall, N. (2013). *Causation: A User's Guide*. Oxford: Oxford University Press.
- Prior, E. (1985). *Dispositions*. Aberdeen: Aberdeen University Press.
- Pyke, S. (1995). *Philosophers*. London: Zelda Cheatle Press.
- Rosen, G. (2010). Metaphysical Dependence: Grounding and Reduction. In B. Hale & A. Hoffmann (eds.), *Modality: Metaphysics, Logic, and Epistemology*, 109–136. Oxford: Oxford University Press.
- Schaffer, J. (2016). It is the Business of Laws to Govern. *Dialectica*, 70, 577–588.
- Schwarz, W. (2009). *David Lewis: Metaphysik und Analyse*. Paderborn: Mentis.
- Schwarz, W. (2012). Models of laws. Wo's Weblog. Retrieved June 24, 2019, from <http://www.umsu.de/wo/2012/585>
- Tooley, M. (1977). The Nature of Laws. *Canadian Journal of Philosophy*, 7(4), 667–698.
- Tugby, M. (2012). Rescuing dispositionalism from the ultimate problem: reply to Barker and Smart. *Analysis*, 72(4), 723–731.
- Van Fraassen, B. C. (1989). *Laws and Symmetry*. Oxford: Oxford University Press.
- Weatherson, B. (2015). Humean Supervenience. In B. Loewer & J. Schaffer (Eds.), *The Blackwell Companion to David Lewis*, 101–115. Oxford: Blackwell.
- Weatherson, B. (2016). David Lewis. In: E. N. Zalta (ed.), *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition), URL = [<https://plato.stanford.edu/archives/win2016/entries/david-lewis/>](https://plato.stanford.edu/archives/win2016/entries/david-lewis/).
- Williamson, T. (2016). Abductive Philosophy. *The Philosophical Forum*, 47, 263–280.
- Williamson, T. (2017). Model-Building in Philosophy. In: R. Blackford and D. Broderick (eds.), *Philosophy's Future: The Problem of Philosophical Progress*, 159–172. Oxford: Wiley-Blackwell.