Humean supervenience and best-system laws[1]

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Abstract

David Lewis has proposed an analysis of lawhood in terms of membership of a system of regularities optimising simplicity and strength in information content. This paper studies his proposal against the broader background of the project of Humean supervenience. In particular, I claim that, in Lewis's account of lawhood, his intuition about small deviations from a given law in nearby worlds (in order to avoid backtracking and epiphenomena) leads to the conclusion that laws do not support (certain) counterfactuals and do not bestow nomic necessity on (certain) facts induced by these laws. Support of counterfactuals and nomic necessity, however, are widely held to be important aspects of the concept of lawhood. In my view, therefore, it is not possible to abandon these criteria in any satisfactory analysis of the notion of laws of nature. In a final section, I suggest that the whole project of Humean supervenience is misleading. It does not sufficiently take notice of the important role that reasoning about contrary-to-fact situations plays in modern scientific practice.

1. David Lewis on Humean supervenience

Much of Lewis's philosophising is motivated by a project which he describes by the term "Humean supervenience" (Lewis, 1986a, p. ix). In his more cautious moments, Lewis considers supervenience as "a denial of independent variation." It is a weaker form of reductionism, "unencumbered by dubious denials of existence, claims of ontological priority, or claims of translatability" (Lewis, 1999, p. 29). Supervenience with respect to nomic concepts is thus defined as the positive answer to the following question (Lewis, 1999, p. 30):

> Suppose that two possible worlds are perfect qualitative duplicates[2] — must they then also have exactly the same distributions of objective probability, the same laws of nature, the same counterfactuals and causal relations? Must their inhabitants have the same de re modal properties?

Only if Humean[3] supervenience is true, does it make "sense to pursue such projects as a frequency analysis of probability, a regularity analysis of laws of nature, or a comparative similarity analysis of causal counterfactuals and de re modality" (Lewis, 1999, p. 30).

Lewis concedes that "Humean supervenience is at best a contingent truth", and that there are in fact possible worlds where one finds "suchlike rubbish" as "extra, irreducible external relations,

besides the spatiotemporal ones; […] emergent natural properties of more-than-point-sized things; […] things that endure identically through time or space" (Lewis, 1986a, p. x).

Once the contingency of Humean supervenience is conceded, one might wonder if it is still possible to construct, for example, a regularity analysis of laws (which is the part of the overall project which interests us here). Such an analysis must allow for some counterfactuals or statements about possible worlds, if it is to be of interest (note that Lewis defines Humean supervenience in terms of relations between possible worlds). To offer sufficient grounds for discussion of counterfactuals or possible worlds, Humean supervenience must therefore hold in a whole class of possible worlds, relevant to ours. Lewis first claimed that there is such a class, because Humean supervenience fails only — so he thought — in worlds which instantiate "extra natural properties or relations that are altogether alien to this world" (Lewis, 1986a, p. x). However an argument by Sally Haslanger, based on the so called Armstrong spinning sphere(or Kripke spinning disk), has led him to abandon this claim. He still maintains that such worlds "don't count as 'worlds like ours'", but does not provide any characterisation of "worlds like ours", other than that Humean supervenience fails in them (Lewis, 1994, p. 475). But without any further grasp on the similarity relation between worlds where Humean supervenience applies, the thesis that our world is such a world is not falsifiable. Whenever one succeeds in constructing a world identical to ours in respect to all occurrent facts but with different laws, there is always the possible answer that this other world is non-Humean.

As is the case for Lewis, supervenience theses recommend themselves to many authors in that they avoid ontological commitments; they are a weaker form of reductionism, because they do not claim that the supervening feature refers to an entity that is non-existent. But one may question if Humean supervenience, defined in a non-ontological way, suffices for a regularity analysis of lawhood where supervenience only holds in a small class of possible worlds, surrounding our own. Consider an example: the system of laws which holds in our world is an a posteriori fact about it. If our world is governed by a sufficiently unified system of laws, it is plausible to suggest that any change in its laws would entail at least some change in the facts occurring in it. If one then chooses as the class of possible worlds, relevant for the examination of Humean supervenience, a subclass of those worlds where all occurring facts are summarised under some law and are not brute facts which just happen,[4] there can be no difference, even for a non-Humean, in the laws of our world (relevant to this chosen sub-class of possible worlds) without any difference in the facts. The acceptance of this claim does not force one to sympathise with a regularity analysis of laws, or with any other reductionist account of modal properties.[5] The example suggests that Humean supervenience with regard to a limited class of possible worlds is not sufficient, as long as one does not have a good independent grasp of that class of possible worlds in comparison to which Humean supervenience is established in our world.

It is therefore noteworthy that in less cautious moments, Lewis tends towards more full-blown forms of reductionism. In On the Plurality of Worlds, he speaks of Humean supervenience in

overtly ontological language, which, if taken literally, implies the denial of the very existence of the supervening features (Lewis, 1986b, p. 14):

> The world has its laws of nature, its chances and causal relationships; and yet — perhaps! — all there is to the world is its point-by-point distribution of local qualitative character. We have a spatiotemporal arrangement of points. At each point various local intrinsic properties may be present, instantiated perhaps by the point itself or perhaps by point-sized bits of matter or of fields that are located there. There may be properties of mass, charge, quark colour and flavour, field strength, and the like; and maybe others besides, if physics as we know it is inadequate to its descriptive task.[6] Is that all? Are the laws, chances, and causal relationships nothing but patterns which supervene on this point-by-point distribution of properties? Could two worlds differ in their laws without differing, somehow, somewhere, in local qualitative character?[7]

Although less prudent, this more overtly ontological version of Humean supervenience clearly shares the intuitions behind the regularity analysis of laws and other Humean-style reductionist attempts. But if the weaker version is a contingent truth, so is the stronger. It will therefore have the same difficulty singling out a sufficiently well-defined class of possible worlds in which it holds. This difficulty inherent in any Humean account shows up especially in connection with the question of lawhood. In which sense (if at all) can such an account provide a sufficient analysis of this concept? Although it might be possible to discuss this question in general, it is easier to focus our attention on the particular account of lawhood given by Lewis.

2. The Mill-Ramsey-Lewis account of laws of nature

The best-system theory of laws has been proposed by David Lewis, on the basis of earlier intimations by John Stuart Mill (1843, book III, ch. IV, §1) and Frank Ramsey (1928, pp. 128–132; 1929, p. 138). It is firmly rooted in the Humean project that seeks to establish lawhood on the basis of events actually happening in our world and looks therefore for a definition of laws in terms of the actual history without resorting to modality or possible worlds, and without taking nomic necessity to be an unanalysable primitive. This theory can claim our attention on at least three grounds: first, it is a metaphysically modest candidate for an account of laws of nature (in comparison, for example, with David Armstrong's account, relying heavily on universals); second, it offers a non-epistemic approach (as it does not make the lawhood of a statement dependent on our knowledge of it being a law or even on our knowledge of it being true). Third, it avoids several problems which debilitate the most obvious Humean account of laws, the naive regularity view. Accordingly, the best-system approach is appraised, by friends and foes of the Humean programme alike, as providing "the best hope of empiricist analysis of laws" (Earman, 1984, p. 198), as "the best that a Regularity theorist can do when faced with the problem of distinguishing between laws of nature and mere accidental Humean uniformities" (Armstrong, 1983, p. 67). It provides therefore a suitable test case for the Humean project in general.

If one wants to tie laws as closely as possible to the facts occurring in our world, the most natural candidates for laws of nature are true generalisations. But it will not do to equate laws with true generalisations — as the naive regularity view does — because there are “accidental” regularities. It is certainly true that no river, past, present and future, is made up of milk; nevertheless, we would not be prepared to call this true generalisation a law. If the Humean project is to succeed at all, one therefore needs a criterion which distinguishes between mere accidental regularities and laws of nature.

Lewis (1973, p. 73) chooses as his criterion membership in a system which optimally combines simplicity and strength in information content:

> A contingent generalization is a law of nature if and only if it appears as a theorem (or axiom) in each of the true deductive systems that achieves a best combination of simplicity and strength.

In opposition to the naive regularity view, lawhood is no longer a propriety of single propositions, but it is defined against the background of a whole cluster of laws. Laws of nature are the regularities that figure in the best possible scientific theories. Essential features of a best theory are, according to Lewis, its being “entirely true”, “closed under strict implication”, “as simple in axiomatisation as it can be without sacrificing too much information content”, and its having ”as much information content as it can have without sacrificing too much simplicity” (Lewis, 1999, p. 41). Simplicity and strength in information content will often be in competition; a best system is characterised by the balance between both virtues. Lewis does not rule out the possibility that the ideal system contains particular facts about our universe; “however, only the regularities in the best system are to be laws” (Lewis, 1986a, p. 123). Similarly, the definition rules out any necessary truth: although they are part of the best system (as of any deductively closed system), only a “contingent generalization” can be a law (Lewis, 1973, p. 73).

David Lewis proposed an extension of his approach to include laws involving (objective) chance. At first he thought that one has to abandon his initial project of Humean supervenience in this context. Whereas in the original account (without chance), “no two worlds could differ in laws without differing also in their history”, the amended account had to admit chances as primitive in addition to “the pattern of particular fact [sic] throughout the universe” (Lewis, 1986a, p. 127, cf. pp. 124–131). More recently, Lewis has come to the conviction that chance cannot rip the Humean splendour off the best-system approach (1994, pp. 473, 486).[8] Be this as it may, it is worthwhile to enquire about the feasibility of the best-system theory of laws in its original form. Strengths and weaknesses of the approach will become clearer, undisturbed by difficulties due to the presence of chance.[9]

There has been widespread concern in the literature as to whether best-system laws are well-defined. In particular, it is no easy task to define simplicity, strength in information content (and the balance between them), and it is not clear that Lewis has come up with any functional proposal in his account of lawhood (cf. for example Armstrong, 1983, p. 67; Carroll, 1994, pp. 49–54; Van Fraassen, 1989, pp. 41–42, 56–58.). But even if one assumes, for the sake of the argument, that best-system laws are well-defined, one still has to ascertain that the definition

is appropriate as an analysis of the concept of law, that is: are best-system laws laws, in any of the usual senses of the word? The discussion here will concentrate on this single question of lawhood. At first sight, any answer to the question seems to be threatened by circularity: we surely need an analysis of lawhood before being able to decide if something is a law! But if we had such an analysis, probably we would not bother about best-system laws. Nevertheless, even without having at hand a full-blown analysis of lawhood, one can still check if the proposed analysis at least meets criteria commonly agreed on as necessary for something to be a law. The discussion will focus on two criteria: support of counterfactuals and nomic necessity.

3. Support of counterfactuals

Laws differ from accidental regularities in the respect that the former support counterfactuals, the latter do not. All massless particles move with the velocity of light; therefore, if an electron were massless, it would move with the velocity of light. All fruits in Smith's garden are apples; therefore (?) if a peach were introduced into Smith's garden, it would be transformed into an apple (cf. Tooley, 1977, p. 686). Perhaps such gardens exist in fairy-tales, but they typically take place in worlds not physically accessible from our world, worlds where our laws of nature do not hold. In our world, it is simply an accidental truth that all fruits in Smith's garden are apples; no counterfactual can be deduced from it. Support of counterfactuals therefore seems a good test for lawhood. Now do best-system laws support counterfactuals?

Authors disagree on the question. Peter Forrest (1985, pp. 7–8) thinks that best-system laws support counterfactuals, but complains that this is worthless because it is only achieved by definition; one places the counterfactual situation in worlds where the best-system laws hold. David Armstrong (1983, p. 69) takes Lewis to affirm counterfactual support from best-system laws, but considers that this cannot be true; as "the best deductive system is a mere de facto systematization. Why should new objects or changed objects conform to it?" In fact, in Lewis's own account laws do not support counterfactuals, because he allows small deviations from the laws in very close worlds and analyses counterfactuals in terms of closeness between possible worlds.

Consider the example of a deterministic world used by Lewis when he first put forth the best-system theory (1973, p. 75):

> Suppose a certain roulette wheel in this deterministic world i stops on black at a time t, and consider the counterfactual antecedent that it stopped on red. What sort of antecedent-worlds are closest to i?

On the one hand, there are worlds where the same laws hold as in i. Then the past in these worlds has to differ (and perhaps to differ considerably) from the past in i, to allow for the wheel to stop on red instead of on black. On the other hand, we have worlds with exactly the same past until shortly before t, "where the laws of i hold almost without exception; but where a small,

localized, inconspicuous miracle at t or just before permits the wheel to stop on red in violation of the laws" (Lewis, 1973, p. 75). Lewis considers the second group of worlds closer to the original world than the first. But in this case, laws no longer support (certain) counterfactuals.

To prove this conclusion, consider the idealised case[10] where the laws of i (probably only together with some particular facts, shared by i and the counterfactual worlds) entail the following regularities:

(1) If the wheel is on a red field at (t-ε), it will stop on a black field at t.

(2) If the wheel is on a black field at (t-ε), it will stop on a red field at t.

Then, if in i the wheel is on a black field at t, it is on a red field at (t-ε). (1) entails the following counterfactual:

(3) If the wheel were on a red field at t, it would be on a black field at (t-ε).

Following Lewis's analysis of counterfactuals in terms of possible worlds (1986a, p. 164), (3) is equivalent to:

(4) Either there is no world where the wheel is on a red field at t, or some world where the wheel is on a red field at t and on a black field at (t-ε) is closer to i than any world where the wheel is on a red field at t and is not on a black field at (t-ε).

As there are possible worlds where the wheel is on a red field at t, and as not-being-on-a-black-field is the same as being-on-a-red-field, (4) can be simplified to yield:

(5) Some world where the wheel is on a red field at t and on a black field at (t-ε) is closer to i than any world where the wheel is on a red field at t and at (t-ε).

But (5) is not true, because the world with "a small, localized, inconspicuous miracle" between (t-ε) and t is a world where the wheel is on a red field at t and at (t-ε), and according to Lewis, it is closer to i than the world where the laws hold, i.e. where the wheel is on a red field at t and on a black field at (t-ε). Therefore the counterfactual (3) is false.

The example considered shows that, in Lewis's account, laws do not support all of those counterfactuals that one would expect them to support. In fact, Lewis invokes this kind of small "miracle" quite generally in backtracking contexts (1986a, pp. 44–49).[11] Therefore, even on his own account, laws do not support backward-directed counterfactuals. One should note that the proof does not use any particular feature of the best-system theory. As long as you go along with Lewis's intuitions about comparative similarity between worlds, with respect to violation of laws, laws do not support (certain) counterfactuals.

4. Counterfactuals and causation

For somebody who wants to safeguard law-supported counterfactuals and still analyse counterfactuals in terms of similarity between possible worlds, an escape route exists. That

person could resist Lewis's lead on "miracles" and contend that the closest worlds are in fact those where our laws are true generalisations. This proposal would yield the desired result. Why then does Lewis not adopt this view?

One major reason lies in his extensive use of the possible-worlds formalism in the analysis of causation (and other related contexts which do not allow for time-reversal, as for example the "openness" of the future). Here, he needs "small, localized, inconspicuous miracle[s]" (Lewis, 1973, p. 75) to avoid backward causation and to grapple with epiphenomena (Lewis, 1986a, pp. 170–171). In both cases, the desired counterfactuals are in fact the exact opposite of those supported by laws.

To prove the point, consider once again the deterministic world i, where the laws (1) and (2) govern the behaviour of the roulette (cf. p. 6 above). These laws yield the counterfactual (cf. p. 6 above):

(3) If the wheel were on a red field at t, it would be on a black field at (t-ε).

But according to Lewis's analysis of causation, (3) implies that the wheel-being-on-the-red-field-at-t causes its-being-on-the-black-field-at-(t-ε). (3) is therefore a case of backward causation, where the effect is said to cause the cause. In the context of an analysis of causation, (3) is false and must be replaced by (3'), when one remembers that in the actual world the roulette is on a red field at (t-ε):

(3') If the wheel were on a red field at t, it would be on a red field at (t-ε).

(3') holds in virtue of the fact that the closest world to i is exactly the world with "a small, localized, inconspicuous miracle" between (t-ε) and t, i.e., where the wheel is on a red field at t and at (t-ε).

Lewis acknowledges that the similarity relation he uses differs in several respects from our intuitive grasp of closeness between possible worlds, but is constructed so as to yield the correct truth conditions for the counterfactuals related to his analysis of causation. In fact, "our explicit judgments of overall similarity" are likely to differ from the similarity relation which should be used in careful analysis, as this latter "is a resultant, under some system of weights or priorities, of a multitude of relations of similarity in particular respects" (Lewis, 1986a, p. 43). While elaborating the similarity relation, it is necessary to adjust our intuitions to the needs of the analysis and sometimes even to abandon them completely.[12] Although Lewis gives independent argument to try to convince us that small miracles contribute to similarity of worlds(LEWIS, 1973,. 75–77), he has to come down this way in any case if he wants to use closeness between possible worlds in his counterfactual analysis of causation.

5. Either for context-dependency or against backtracking

In face of the conclusion that laws of nature and causation yield opposing results for support of counterfactuals and similarity between possible worlds, one can adopt two strategies. Both follow lines indicated by Lewis's philosophy, but are nevertheless conflicting. One must either concede the context-dependency of the truth-conditions for counterfactuals or give up support of (certain) counterfactuals as a criterion for law.

In support of the first strategy, one can point to places where Lewis admits the vagueness of counterfactuals: their validity and, consequently, the similarity relation between possible worlds are context-dependent. The choice of counterfactuals affirmed depends on our particular interests. Worlds are only similar in so far as we have made our mind up as to which similarities matter to us (Lewis, 1973, p. 92):

> The truth conditions for counterfactuals are fixed only within rough limits; like the relative importances of respects of comparison that underlie the comparative similarity of worlds, they are a highly volatile matter, varying with every shift of context and interest.[13]

Considering backward-directed counterfactuals, Lewis distinguishes therefore between a resolution of the vagueness allowing backtracking and what he calls the "standard" resolution avoiding backward causation.

Calling the non-backtracking resolution "standard" hints nevertheless at the second strategy: for Lewis, the similarity relation needed in the context of causation has a privileged status. It is certainly this relation (and not that needed for counterfactual support by laws) that is most prominent in his writings. This is not only true when he tackles causation (where one would expect it), but also, more surprisingly, when he discusses laws of nature.[14] If this intimation is followed, context-dependency of counterfactuals (with regard to causation and laws) is avoided, but at the price of divorcing counterfactual support from lawhood.

It is not easy to say which of the two mutually exclusive strategies is more in tune with Lewis's own intentions: the first fits in better with his awareness of the context-dependency of counterfactuals and similarity relations between possible worlds, but the second dominates his explicit discussions of laws of nature. What reasons are there for Lewis to "export" the similarity relation used in his account of causation to the context of laws?

First, Lewis is certainly not happy with thorough-going relativism in regard to truth conditions for counterfactuals. Although he recognises the role of context in assessing counterfactuals, he contends that "it can happen also, and often does, that a counterfactual has the same truth value according to all permissible systems of spheres, and so is definitely true or definitely false" (Lewis, 1973, p. 93). But as long as backtracking with regard to both causation and laws of nature is not excluded, backward-directed counterfactuals have different truth values in these two contexts.

Second, causation is not only a prominent theme in Lewis's writing, but it also plays an essential role in his Humean project. This constitutes a strong incentive to provide an objective account of it. As causation, for instance, is essential for the persistence of things (and persons) throughout time, according to Lewis, he cannot retreat into a subjective paradise; objective causation matters as long as we are not prepared to see our own self-identity as dependent on whatever interests we (or others) might happen to hold.

Third, Lewis claims that backtracking counterfactuals present peculiar features which are best resolved by resisting them: they commit us to fallacious reasoning about some forward-directed counterfactuals, are more naturally formulated in terms of "would have to have", and do not generally lead to clear-cut intuitions (Lewis, 1986a, pp. 32–35).[15] As these features are not directly relevant to the concept of laws, let us turn finally to a reason which is a consequence of the best-system approach: the latter allows the weighing of similarity of laws against similarity of facts, and sometimes facts win over laws with respect to closeness of possible worlds (Lewis, 1986a, pp. 163–164):

> The respects of similarity and difference that enter into the over-all similarity of worlds are many and varied. In particular, similarities in matters of particular fact trade off against similarities of law. The prevailing laws of nature are important to the character of a world; so similarities of law are weighty. Weighty, but not sacred. […] Likewise, similarities or differences of particular fact may be more or less weighty, depending on their nature and extent. […] It may be worth a small miracle to prolong or expand a region of perfect match [concerning particular fact].

Weighing similarities (or differences) in facts and laws against each other, in the way that Lewis does it, presupposes a kind of "common measure" between them. It is not clear how anyone committed to a strong (i.e. non-reductive) view of laws could derive such a relation of overall similarity between possible worlds, including both laws and facts.[16] But if laws are basically regularities, that is patterns of particular facts, such a procedure might become feasible, and in that case "laws are very important, but great masses of particular fact count for something too" (Lewis, 1973, p. 75) in establishing the similarity between worlds. Therefore Lewis's commitment to the program of Humean supervenience, from which flows the best-system theory of laws, has certainly inclined him to accept, under certain conditions, violations of laws of nature in nearby worlds in order to safeguard matches concerning particular fact.

6. Nomic necessity

Laws of nature are in general considered to be true;[17] therefore "If 'It is a law that A' then A". Best-system laws meet this criterion of inference, because they are chosen among true generalisations. They are also contingent, i.e. they are not true in all possible worlds. So far, so good; but most would locate laws of nature somewhere in between the two extremes of contingency of facts and logical necessity. Therefore "If 'It is a law that A' then 'It is (nomically) necessary that A'". Do best-system laws meet this criterion?

They do — by definition. For Lewis, nomic necessity is defined via the laws: A is nomically necessary iff A is implied by the laws of nature.[18] This move is perfectly legitimate, as Lewis has given a definition of laws that does not use the concept of necessity. Nevertheless, we may be suspicious about the purely formal way of establishing the equivalence. Is the link between nomic necessity and best-system laws so basic that we might accept it as being built into our language?[19] Do we know nothing about nomic necessity, independent of best-system laws?

One way to explore our knowledge about nomic necessity, even without having at hand a full-blown analysis of it, consists in looking at concrete examples of simple worlds (often called toy worlds), where we can check if best-system laws provide the postulated link to necessity. Consider a world in which classical mechanics is valid plus Newton's law of gravitation. The only objects populating the world are golden spherical objects which move in stable orbits around one another. The regularity "All objects are spherical" certainly gains access to the toy world's best system. But are we prepared to say that, in this world, all objects need to be spherical? A slight change in the initial conditions could have made some of them collide, so that they would have broken into two non-spherical parts.[20]

There is a ready answer to arguments based on toy worlds: Humean supervenience is, according to Lewis himself, only a contingent truth. It does not apply to all possible worlds. The golden sphere world is perhaps a world where laws do not supervene on facts. What about nomic necessity in our world?

In order to answer this question, it is a natural move (especially in the broader context of Lewis's philosophy) to reformulate nomic necessity in terms of possible worlds and to define worlds nomologically (or physically) accessible from our world as those worlds where its laws are true.[21] Nomologically necessary propositions are defined as those propositions which are true in all worlds nomologically accessible from our world. If one considers that the best-system laws are the laws of our world, one gets the desired result: facts entailed by the best-system laws are nomically necessary. But again the result has been reached by pure definition and lacks any explanatory content (Van Fraassen, 1989, pp. 44–46).

To get away from a purely formal definition of nomic necessity, one needs to show that facts entailed by the best-system laws are true in a class "relevant" to our world, so that it makes sense to define nomic necessity with respect to this class. There are not many potential candidates. One such would be worlds where no alien natural properties are instantiated. Lewis himself, however, has already told us that this solution does not work (1994, p. 475; cf. p. 2 above). Spheres of nearby worlds are another candidate. Are facts entailed by best-system laws true in nearby worlds? At first, one is inclined to think they are. If a fact A is entailed by a law, it is "tied" to other facts by virtue of this law. Consequently, if A changes, a lot of other facts also have to change. Therefore a change in a law-induced fact brings us further from a given world than a change in an accidental fact.

Alas, this reasoning is fallacious. It presupposes that best-system laws give the needed correlation between particulars facts. But it is not clear how they could, as they are basically

regularities. In a world where a fact A does not pertain, the law that induces it in our world is not a law, and it is not even true; but all the other facts induced by the law might still hold. The resulting world is certainly still very close to the original world. Interestingly enough, this is Lewis's own conclusion. Although he claims that "similarities of law are weighty", they are "not sacred. We should not take it for granted that a world that conforms perfectly to our actual laws is ipso facto closer to actuality than any world where those laws are violated in any way at all" (Lewis, 1986a, pp. 163–164).

In fact, this outcome does not come as a surprise, after our discussion about counterfactuals. Certain counterfactuals are not supported by laws, in Lewis's analysis, because the laws of our world do not hold in some very nearby worlds; small "miracles" are allowed for. If one defines nomic necessity in terms of truth in nearby worlds, one is automatically led to the result that best-system laws do not bestow nomic necessity on certain facts induced by these laws.

John Halpin (1998, pp. 358–359; 1999, pp. 639–640) has proposed another candidate for a "relevant" class of worlds in what he calls the perspectival best system account: physically accessible worlds are now defined as those worlds which one constructs by selecting some initial conditions (compatible with the laws of our world) and then extrapolating their evolution through time according to our laws; our laws are taken to function as the laws of such an extrapolated world, even if its own laws (according to its own best system) are different. The proposal presents the double advantage of no longer arriving at nomic necessity for law-induced facts by fiat (and therefore goes some way towards an "explanation" of such a necessity) and of being closely linked to scientific practice: the extrapolated worlds are exactly those possible worlds that interest scientists as models of our world (or of a scientific theory, if one extrapolates not according to the actual laws, but according to the laws postulated by the theory).

Nevertheless, there are reasons to think that extrapolated worlds do not provide a satisfactory answer to the challenge raised by nomic necessity to the best-system account. First, the perspectival best-system account does not avoid a distinctively subjective flavour. It is true that it inherits from the original best-system account the fact that laws do not depend on our knowledge of them, and it can make sense of laws in worlds without any cognitive beings (Halpin, 1999, pp. 638–639). But on the other hand, it makes nomic necessity dependent on our scientific practice: law-induced facts are necessary because scientists happen to have certain ways of modelling that require extrapolated worlds. Thereby nomic necessity presupposes at least the existence of cognitive beings similar to actual scientists in some possible world (if you are not a realist about possible worlds, they have to live in the actual world, as luckily is the case). In all probability, only strongly entrenched empiricist convictions would make such a reconstruction of nomic necessity attractive.

Second, it is not clear how Halpin's proposal can tackle with some of the counterexamples he has himself formulated against Lewis's original account. He considers a possible world very similar to ours, up to a time t at which a small difference occurs, say a person coughs when she does not in our world. Extrapolating the future of a "coughing world" according to the laws of the

actual world may yield (for example, via chaos) a very different pattern of occurring facts in that world, compared to ours. As the best system supervenes on particular fact, it is plausible to think that the best-system laws of this world are different from the actual ones, and that they may even contradict them (Halpin, 1999, pp. 356–357).[22] If this second case is a real possibility, such a coughing world is an example of an extrapolated world where our own laws are not true (because contradicted by the best-system laws, which are by definition true). In that case, extrapolated worlds cannot function as the class of physically accessible worlds providing nomic necessity.[23]

How serious the second objection is taken depends on how the possibility of such coughing worlds is considered. Even if they are quite counterintuitive in the deterministic case, their probabilistic analogue (i.e. "undermining worlds") receives great attention in the discussion on the possible extension of the best-system account to include statistical laws (for example Lewis, 1994, pp. 482ff; Thau, 1994, p. 495; Halpin, 1998, pp. 633–635). Further argument would be needed to show that the perspectival best-system account can overcome the difficulties which coughing and undermining worlds point to.

The difficulty in coming up with an interesting class of worlds by which to assess nomic necessity confirms a suspicion we could have held right from the start: if laws are basically regularities, they cannot bestow any necessity on the facts they entail. Embedding these contingent regularities of our world in spheres of similar worlds has not proved to be very helpful. "Truth and simplicity [prominent criteria for best-system laws] just do not add up to necessity" (Van Fraassen, 1989, p. 47). To my knowledge, Lewis never addresses this problem directly. Instead, he seems to suggest that counterfactual support and nomic necessity are questions that do not really matter for an analysis of lawhood. Thus (Lewis, 1994, pp. 478–479):

> If you're prepared to agree that theorems of the best system are rightly called laws, presumably you'll also want to say that they underlie causal explanations; that they support counterfactuals; that they are not mere coincidences; that they and their consequences are in some good sense necessary; and that they may be confirmed by their instances. If not, not. It's a standoff — spoils to the victor.

This is a perfectly legitimate stand for someone happy with Quine's slogan that "necessity resides in the way we talk about things, not in the things we talk about" (Willard Van Orman Quine, Ways of Paradox, quoted by Plantinga, 1974, pp. 26–27). Bas van Fraassen's work on laws of nature points clearly in this direction (1989, p. 68, n. 1 (on p. 354), pp. 91–93, and passim). It is less clear how acceptable this attitude might be for Lewis. This is so not only because of his realism about possible worlds (a feature of his philosophy not directly involved in his analysis of lawhood), but also because of the very attempt to provide an analysis of lawhood. Counterfactual support and nomic necessity of some kind are clearly part of the concept itself. As long as Lewis pretends to give an objective account of laws, he must find a way to allow for objective modal features of our world.

7. On the reasons for (not) being Humean

Having established the failure of the best-system theory, Bas van Fraassen concludes that "the last hope for an empiricist account of law, that a little sacrifice to anti-nominalism would ward off peril, is gone" (Van Fraassen, 1989, p. 64). Two reactions are possible in the face of this acknowledgement: either one looks for a non-Humean account of laws of nature, or one abandons the concept altogether. The second very much resembles a solution of despair; concepts with nomic commitments play a very central role in a diverse range of domains, so that it is not a promising programme that would try to get rid of lawhood (Carroll, 1994, pp. 5–12). Causal laws occupy, in particular, a prominent place in guiding our actions. Some have tried to argue that "a universal of fact is within its scope just as good a guide to conduct as a universal of law" (RAMSEY, 1928, p. 138).[24] Nevertheless, it is a bad strategy to introduce a peach into Smith's garden when one desires an apple (and is reluctant to steal one), even if all the fruits in this garden are apples!

Therefore we are left with the first alternative: elaborating a non-Humean account of laws of nature. The concluding section of this article is certainly not the right place to engage in such an ambitious program. Thus I will limit myself here to another question: given the highly counterintuitive character of the Humean project and the serious difficulties faced by any detailed elaboration of it, why would anybody want to be Humean in the first place?

One major motivation is certainly the worry arising out of what seems to be "our lack of 'direct perceptual access' to causal connections" (Carroll, 1994, p. 5): we can only observe constant conjunctions, but never necessary ties between events. If, therefore, laws cannot be reduced to regularities, we can never have knowledge of them, although we ordinarily think we do.

Notwithstanding this widespread worry, I would like to claim that scepticism about the epistemic accessibility of nomic connections stems from the neglect of one central feature of scientific practice: what characterises modern science is that it works not so much through observation, but through experimentation. The empiricist's unwillingness to accept counterfactual evidence does not take into account the fact that our experimental activity largely involves bringing mere possibilities into actuality; the history of our world does not simply happen, we make it happen — even if in a very modest sense (Von Wright, 1974, § II.4, pp. 52–53):

> If man throughout stood quite "passive" against nature, i.e. if he did not possess the notion that he can do things, make a difference to the world, then there would be no way of distinguishing the accidental regularity from the causal one. Nor would there be any way of distinguishing the case when p has the "power" of producing q from the case when some factor r has the "power" of producing the sequence of q upon p. Man would simply not be familiar with the notion of counterfactuality, with the idea of how it would have been, if —.

If one maintains that knowledge depends on direct experience, then one has to concede that we can never possess strict knowledge of the contrasting situation because it is "contrary to fact". Nevertheless the very concept of action includes the "contrast between a state of affairs resulting from the action and another state which would otherwise, i.e. had it not been for the

performance of the action, have obtained. […] On this implicit trust in counterfactuals rests our conviction that we perform actions and that we are agents who can act" (Von Wright, 1974, § II.2, p. 41).

The thoroughgoing empiricist can try one last escape route: sufficiently lengthy experimentation will probably yield all facts necessary for discrimination between different law claims. Ramsey follows this intimation when he construes the possible world in which human beings[25], motivated by a groundless fear of stomach-ache, never eat strawberries. Their belief concords with all the facts, albeit we consider it false. As Ramsey observes, my conviction stems from the fact that "I have eaten [… strawberries] and not had a pain." Therefore, "what was wrong with our friends the strawberry abstainers was that they did not experiment"; "the system is uniquely determined and […] long enough investigation will lead us all to it" (Ramsey, 1929, p. 149).

One should certainly blame the strawberry abstainers for not being courageous scientists. But are we really prepared to say that, if they do not change, there is no objective relationship between strawberries and stomach-ache in their world (cf. Putnam, 1978, p. 164)? Certainly, they cannot know it. As long as they are merely doing philosophy, they can certainly take epistemic truth for ontological reality. But as soon as they start to act in the world, they can no longer content themselves with "facts". They would do better to live in a world with objective laws!

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[2] Here Lewis considers that duplication can only be defined with the help of natural properties ("two things are qualitative duplicates if they have exactly the same perfectly natural properties", p. 27), because defining duplication by appeal to shared intrinsic properties would be circular (p. 26). However, in "Defining 'Intrinsic'", with Rae Langton, 1998, (Lewis, 1999, p. 118), he advances a definition for (pure) intrinsic properties, which does not employ the concept of duplication: "having or lacking the property is independent of accompaniment or loneliness" (with respect to "a contingent object distinct from itself", p. 123).

[3] Throughout this article, I do not use the word "Humean" in a historical sense, but as a description of the cluster of approaches to laws of nature characterised by the above phrase. The question if Hume was a "Humean" in this sense is of no interest to my argument.

[4] It is plausible to think that only worlds with this characteristic are close to our own world if, as is postulated, it is governed by a unified system of laws. This excludes in particular the "Hume" world, i.e. the world where all occurrent facts are like in ours, but where there are no laws.

[5] I suggest that similar difficulties beset Lewis's definition of materialism as a supervenience thesis: "Among worlds where no natural properties alien to our world are instantiated, no two differ without differing physically; any two such worlds that are exactly alike physically are duplicates" (Lewis, 1999, p. 37). At least some dualist views on human nature would not be excluded by this definition. The central claim of theism is also compatible with this definition, as God's existence has physical consequences, through his work in creation and redemption.

[6] Does Lewis include dispositions in the allowed "local intrinsic properties"? I have not found an explicit answer to this question in his writings, but tend to think that it has to be negative. Dispositions are too closely related to laws of nature, they are too overtly nomic concepts for an analysis of laws of nature including them to count as reductionist in any sense (cf. Carroll, 1994, p. 6). In addition to this consideration, there is the question if dispositions are intrinsic properties. On Lewis's account of lawhood, they turn out to be extrinsic, because "a lonely thing […] would be subject to no laws, for lack of a cosmos to serve as lawmaker" (Lewis, 1999, p. 124), although he indicates an amended definition for intrinsic that turns dispositions into intrinsic properties (Lewis, 1999, p. 125, n. 11).

[7] Italics are mine. Already in the introduction to his Philosophical Papers, vol. 2, Lewis defines Humean supervenience as an ontological claim: "Humean supervenience … is the doctrine that all there is to the world is a vast mosaic of local matters of particular fact, just one little thing and then another." (1986a, pp. ix–x). In fact, he does not seem to distinguish clearly between both versions.

[8] He draws on an idea by Michael Thau. Cf. Thau, 1994, pp. 491–503.

[9] For a discussion of the extension of the best-system approach including chance, cf. Halpin, 1994, pp. 317–338; Halpin, 1998, pp. 349–360; Sturgeon, 1998, pp. 321–335.

[10] In particular, the roulette wheel is taken to have only red and black fields; other fields are of no pertinence to the argument. In addition, the wheel is supposed to slow down in a single, well-defined way, which allows not to take into account its velocity at (t-ε). The miracle is supposed to take place between (t-ε) and t.

[11] Lewis allows for backtracking under exceptional conditions (as for example in a time machine or at the edge of a black hole (1986a, p. 35), but these exceptions are without interest here. Note that the so-called miracles are not miracles in the usual sense of the term. They are contrary to the laws of our world, but not to those of the possible world in which they happen. As Lewis defines laws as true generalisations, miracles in the strict sense of the word are ruled out a priori.

[12] As is the case for the out-ruling of pre-eminence of perfect match over against imperfect match, which Lewis thinks important. He agrees with his opponents that this pre-eminence is counter-intuitive (1986a, p. 46).

[13]. It is not clear to me how these interests themselves could be explained in terms of Humean supervenience on local, intrinsic properties. Cf. Lewis, 1986a, p. 163. Cf. the discussion of the context-dependence of counterfactuals by Van Fraassen, 1980, pp. 115–118. Van Fraassen considers that it is of no use to analyse causation in terms of counterfactuals, and rejects support of counterfactuals as a criterion for laws of nature.

[14] As in the passage quoted above (p. 5) from LEWIS, 1973, p. 75.

[15] For a critical assessment of these claims, cf. Lange, 2000, pp. 66–73.

[16] In case he really managed to weigh similarities in laws against similarities in facts, one would anyway expect the former to win over the latter.

[17] Carroll, 1994, pp. 22–23 provides references to dissenting views.

[18] I follow the reconstruction van Fraassen (1989, p. 44) offers of Lewis's concepts of nomic necessity and nomologically (or physically) accessible worlds; van Fraassen's treatment clearly captures Lewis's use of the concepts (Lewis, 1973, pp. 72–73; and 1986b, pp. 7, 20).

[19] Van Fraassen, 1989, p. 46, provides an example which even suggests that the link between physical necessity and law (quite independent of the particular account one adopts) is less straightforward than a definitional equivalence can possibly allow for.

[20] This toy world is a simplified version of Van Fraassen's example (1989, p. 47). In his toy world, there are also, in addition, much smaller iron cubes "lying on their surface"; but this does not seem possible in a classical world with

gravitation. Moreover, he does not worry about the question if the golden spheres can evolve on stable orbits in the presence of the iron cubes. The iron cubes serve to reinforce the impression that golden objects are contingently spherical, but the addition is not essential to the argument. Halpin, 1998, p. 357, proposes an even simpler toy world: a classical world with gravitation, populated by only one particle. But it is probably not fair to use such an impoverished world against Lewis's account, because it is not even clear how to make sense of the concept of generalisation in that context. Halpin needs to consider counterfactually the presence of a second particle. This move constitutes a huge change in such a simple world, and it is not clear how his argument can then be of any relevance to the original toy world.

[21] Note that the law need not hold as a law in the considered class of worlds.

[22] It does not matter for the argument if the coughing is introduced "miraculous" or by changing the past.

[23] Halpin, 1999, p. 359, claims that our laws are true in coughing worlds. But this claim is contrary to the very definition of the interesting samples of them, whose best systems are said to contradict actual laws. Halpin, 1998, p. 357, uses coughing worlds to highlight the fact that the best-system account suggests "an implausible causal control that coughing has over laws." But I do not see how his own proposal escapes the same charge, as it stills defines laws in our world via its own best system. Coughing worlds show, in fact, that it is not intuitively clear that best-system laws are the right candidates for laws of nature. Especially, we tend to think of laws of nature as fixed once and for all, whereas in Lewis's account, they supervene on the whole of world history. If laws are sensitive to small changes at one moment of history (as the example suggests), it might well be hopeless to come to know them (even approximately) before the end of history.

[24] But see his more sophisticated account in Ramsey, 1929, pp. 141ff.

[25] Or their counterparts if one goes with Lewis on the question of identity across worlds.