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TRANSITION PERIODS AND MIRACLES

***Abstract**. We argue that small miracles and transition periods, notions that play part in Lewis's standard resolution of vagueness of counterfactuals, lead his theory to errors, either by giving conditionals wrong truth values, or by going against other Lewis's views. In fact, we do not believe that Lewis needs these notions. We suggest a way how his theory could be reformulated without them, in a way that does not disturb other parts of his system. More precisely, we argue that the asymmetry of counterfactual dependence can be reduced to the asymmetry of overdetermination even if the relation of similarity is determined without notions of small miracles and transition periods.*[1]

A counterfactual conditional "If it were the case that A it would be the case that C", where A and C are false propositions claiming that some events *a* and *c* (respectively) occurred, is true at the actual world according to Lewis's theory iff C is true at certain possible worlds. These worlds have the same history as our world up to a time shortly before *a*, when there occurred a so-called small miracle, which led to A being true. The theory says that there is a transition period between the occurrence of the small miracle and the event *a*. Our point in this paper is that transition periods and small miracles are notions Lewis could do without. We will argue that they lead to problems, and we will suggest a way his theory could work without them.

Small miracles are part of Lewis's philosophical system. Our paper begins with explaining the role that this part plays in the system and puts it in the context of the questions Lewis deals with. This includes an explanation of the method Lewis developed to determine the similarity relation, which led him to the notions of small miracles and the transition period. We try to show, first, that the very same method does not favour the worlds with the transition period

1 We would like to thank Miloš Arsenijević and Milan Jovanović for encouragement and helpful discussions. Our first plan was to write a joint paper with Milan Jovanović, but he left us to take a job in another city. We benefited form discussions with him especially about the transition period problems.
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but that there are worlds without it that are at least equally similar to the actual world. Next we try to show that our candidates for the most similar worlds are better, since the worlds Lewis chooses lead to two kinds of problems: mismatch with the way conditionals are used in natural language, and mismatch with other Lewis's views. At the end we examine what would be the consequences, if what we claimed was right, to Lewis's impressive explanation of the relation between various asymmetries. We conclude that there might be a way to avoid bad consequences, and that the rest of Lewis's system need not be changed. More precisely, we will argue that small miracles and transition periods are notions introduced to provide a link between the asymmetry of counterfactual dependence and the asymmetry of overdetermination, but that the link could be provided even without these notions.

As we said, our goal is to exactly follow Lewis's method for determination of similarity. So we begin with sections explaining the background of Lewis's system, and in the other sections we will defend our points.

1. Background 1: Humean Supervenience

In these introductory sections two reductionist programs will be mentioned: Lewis's Humean supervenience and Goodman's program, which can also be called Humean. As Stalnaker explained[2], both were animated by Humean scepticism about natural necessity and felt need for a reductive analysis of a family of notions, including causal dependence and independence, capacities, dispositions, potentialities, and propensities. Let us give these a name for the purpose of this paper and call them 'non-basic notions'. We will keep an eye on them and watch if they appear at the right places in the chain of Lewis's reductions.

Lewis summarises his central idea this way:

2 Stalnaker 2015. p. 411.

> Humean supervenience is named in honor of the great denier of necessary connections. It is the doctrine that all there is to the world is a vast mosaic of local matters of particular fact, just one little thing after another. (But it is no part of the thesis that these local matters are mental.) We have a geometry: a system of external relations of spatio-temporal distance between points, maybe points of space-time itself, maybe point-sized bits of matter or aether or fields, maybe both. And at those points we have local qualities. And that is all. There is no difference without a difference in the arrangement of qualities. All else supervenes on that.[3]

Lewis takes Humean supervenience to be a contingent thesis, and rather than proving its truth he is more concerned with its *tenability*[4]. He explains his main task this way:

> What I want to fight are *philosophical* arguments against Humean supervenience. When philosophers claim that one or another commonplace feature of the world cannot supervene on the arrangement of qualities. . . . Being a commonsensical fellow (except where unactualized possible worlds are concerned) I will seldom deny that the features in question exist. I grant their existence and do my best to show how they can, after all, supervene on the arrangement of qualities.[5]

The way he plans to do this includes a careful order, to avoid circularity, and can be presented this way: (1) laws of nature, (2) counterfactual conditionals, (3) counterfactual dependence, (3) events, (4) causation, (4) the arrow of time, (5) persistence through time, (6) mind, (7) language, etc. (some numbers are repeated on purpose).

Following a suggestion by Ramsey, Lewis determines laws of nature as generalizations "that buy into those systems of truths that achieve an unexcelled combination of simplicity and strength. That serves the Humean cause. For what it is to be simple and strong is safely noncontingent; and what regularities there are, or more generally what candidate systems of truths, seems to supervene safely on the arrangement of qualities.[6]"

Truth conditions for counterfactual conditionals (the next notion in Lewis's chain) are formulated in terms of the relation of similarity among possible worlds. Similarity in turn is determined in terms of perfect match of particular facts and (perfect or imperfect) conformity by one world to the laws of another. In sections 6 and 7 we will talk about the details. For the moment it would be enough to note that both determinations make similarity supervenient on the arrangements of qualities: directly through the perfect match, and indirectly through the conformity to the laws.

3 Lewis 1986., ix-x.

4 Ibid. xi.

5 Ibid.

6 Ibid. Lewis wrote about laws in 1973 and in 1986, Postcript C to Lewis 1979.

2. Background 2: Goodman's Reduction

Before Lewis, Goodman attempted a reductive analysis of counterfactuals. As a reduction, his project was more ambitious, but as a theory of conditionals it was less successful. Here is how Stalnaker explains Goodman's goals[7]:

> It is clear enough why *Hume* thought that notions involving natural necessity were problematic and in need of analysis. All legitimate ideas are copies of, or at least analyzable in terms of sense impressions, and there is no sense impression corresponding to the idea of causation. Goodman's worries about counterfactuals were not tied to Hume's specific doctrine about the empirical basis for concepts, or to the verificationist doctrine that was its twentieth-century descendant, but they are worries that have their source in empiricism. The logical empiricist project of explaining theoretical scientific notions in terms of more directly observational notions was a dauntingly difficult one, but it was evident to those pursuing this project that it would be a lot easier if one were allowed to include a counterfactual conditional operator among the logical resources used for such analyses... Strictly extensional logical resources were unproblematic. Intensional connectives and operators threatened to smuggle non-empirical content into the concepts analyzed in terms of them, but if one could [give] truth conditions for sentences involving such a connective, using only extensional logical resources, that would justify using counterfactuals in one's explanations of the relations between theory and observation.

Goodman's reduction was supposed to be carried out by a definition of truth conditions that included two problems[8]. One was to find a definition, again reductive, of laws of nature, which would distinguish them from accidental generalizations. The other was to define a suitable set of truths that would be sufficient, together with the antecedent and the laws of nature, for the consequent. Both these further definitions were supposed to be given in terms of notions of basic logic. And both failed. We are here interested in the definition of the suitable set of truths. Goodman tried many definitions, and found a counterexample to each of them[9]. They either made all counterfactuals true or none of them. As a last attempt before giving up, Goodman stated a condition that the truths from the set should be *cotenable* with the antecedent, meaning that they should not be false if the antecedent were true. Since cotenability is defined in terms of a counterfactual, using that notion in truth conditions for counterfactuals leads either to circularity or infinite regress. Disappointed, Goodman abandoned his project.

3. Background 3: Loewer's and Stalnaker's Circularity and Lewis's Reduction

The reductive part of Goodman's project was too ambitious, and it suppressed the other part – a theory of conditionals. Presupposing that only a reductive analysis would be useful, Goodman didn't see other goals that could

7 Stalnaker 2015 pp. 412–3.

8 Goodman 1947.

9 More about that and about various interpretations of Goodman's analysis of counterfactuals can be found in Djordjevic 2012.

be achieved. Loewer showed that clearly in his 1979 paper. He kept the circular definition of cotenability, but worked on various formal constraints one might put on the notion of cotenability. These constraints enabled him to make various logical systems for counterfactuals. His truth conditions for counterfactuals given in Goodman's way in terms of cotenability were not useful for estimating the truth value of particular conditionals, but Loewer did achieve much more than Goodman.

Before Loewer, Stalnaker[10] achieved the same, but without using any of Goodman's terminology. A counterfactual is true according to Stalnaker iff the consequent is true at the closest world where the antecedent is true, the 'closest' meaning the world the most similar to our world (if the truth of the conditional is estimated in our world). Stalanker has never attempted to define similarity of worlds. There is no God-given ordering of worlds according to their similarity that enables us to estimate truth values of conditionals. It is rather that we learn about similarity by knowing first which counterfactuals are true. So again we have truth conditions that cannot be used for estimating the truth values of particular conditionals. But there are again formal constraints on the notion of similarity that are enough to build logical systems, and prove consistency and completeness[11].

Lewis's theory is similar to Stalnaker's. The main difference in truth conditions is that Lewis evaluates the consequent in more than one closest antecedent-world. He didn't believe that there must be a unique closest antecedent-world, nor even a group of closest such worlds. He allowed that there could be antecedent-worlds converging to a certain degree of similarity without ever reaching it. What is common to both theories is that truth conditions are formulated in terms of similarity, about which we learn from our intuitions about true and false conditionals, so the conditions are useless for evaluating the truth of particular conditionals. Various logical systems are made again by putting various formal constraints on the relation of similarity between worlds. However, in spite of similarity being determined by our usage of conditionals in natural language, Lewis still believed that similarity could be explained without appealing to conditionals or any of the notions we called non-basic. We mentioned that at the end of our first section above, and we will write about the details again in sections 6 and 7. By examining the ways we use ordinary language conditionals, Lewis came up with generalizations that allowed him to determine similarity in a way that ultimately amounts to arrangements of qualities.

Neither Stalnaker nor Lewis solved Goodman's problem. Lewis's reduction is much different and includes metaphysical notions, while Goodman attempted an epistemologically much more ambitious reduction in terms of extensional logic. (Several attempts have been made to solve Goodman's problem[12], but, as far as we know, Stalnaker was the first to prove that the problem is in principle unsolvable[13].) Stalnaker has never tried to solve this problem. He thought that

10 Stalnaker 1968, Stalnaker and Thomason 1970.

11 Cf. Stalnaker and Thomason 1970.

12 Cf. Bennett 2003, chapters 20 and further.

13 Stalnaker 2015. pp. 413f.

his project was very different from Goodman's, and was surprised[14] when Lewis tried to relate his own theory to Goodman's, to define cotenability in terms of similarity, and to state his truth conditions in terms of the validity of an argument where the antecedent and cotenable premises entail the consequent[15]. However, Djordjevic[16] showed that there is much less in common between the two theories than one might be led to think by reading Lewis's comparison, and that Lewis's notion of cotenability is radically different from Goodman's.

4. Background 4: Backward and Forward Conditionals

Lewis's similarity, as we said, is to be determined by the way we use conditionals. The first such constraint we will mention is about the so-called *backtracking* conditionals. If the antecedent and the consequent of a conditional are entirely about the times t_a and t_c respectively, and if t_c comes before t_a, we will call the conditional backtracking. Examining natural language, Lewis[17] comes to a generalization that ordinarily we think that the way things are later depends counterfactually on the way things were earlier, and that the past is counterfactually independent of the future. If this is so, then all backtracking conditionals are false. However, things are not that simple because there are exceptions. Sometimes we come up with an argument about what would have to be the case earlier for the things to be different now, and use that argument as a justification for a backtracking conditional. For example:

> Jim and Jack quarreled yesterday, and Jack is still hopping mad. We conclude that if Jim asked Jack for help today, Jack would not help him. But wait: Jim is a prideful fellow. He never would ask for help after such a quarrel; if Jim were to ask Jack for help today, there would have to have been no quarrel yesterday. In that case Jack would be his usual generous self. So if Jim asked Jack for help today, Jack would help him after all.[18]

On one hand, we favour forward-tracking conditionals. On the other, we do want to give the conditional under consideration a chance of truth. So we might accept a backtracking conditional. However, Lewis explains that such things happen in special circumstances (with the need for charitable reading and maybe with the help of a backtracking argument), and that after that we *spontaneously* revert back to forward-tracking:

> At this stage we may be persuaded (and rightly so, I think) that if Jim asked Jack for help today, there would have been no quarrel yesterday.

14 He mentioned that in e-mail correspondence.

15 Lewis did that very briefly in 1973a (pages 11–2 in the reprint 1986) and in more length in 1973, section 2.6 and chapter 3.

16 Djordjevic 2013. He also claimed that it is the differences he discovered between the two theories that lead Lewis's theory to serious troubles.

17 Lewis 1979a, pp.32–5 in the reprint 1986.

18 Ibid. p. 32f. This is an example Lewis said he borrowed from Downing 1959.

> But the persuasion does not last. We very easily slip back into our usual sort of counterfactual reasoning, and implicitly assume once again that facts about earlier times are counterfactually independent of facts about later times. Consider whether pride is costly. In this case, at least, it costs Jim nothing. It would be useless for Jim to ask Jack for help, since Jack would not help him. We rely once more on the premise we recently doubted: if Jim asked Jack for help today, the quarrel would nevertheless have taken place yesterday.[19]

Lewis's explanation of the phenomena of backtracking in terms of his relation of similarity goes as follows[20]. First we need to note that counterfactuals are vague, and that fact is matched by his theory by the relation of similarity being only partly determined. Namely, neither formal constraints nor informal description that we will explain in section 7 below are sufficient to determine a single ordering of worlds. Lots of room is still left for similarity to adjust to the context. For example, we can claim that Caesar would have used nuclear weapons, or claim that he would have used catapults had he been in command in Korea. Either claim is right in the right contexts. The similarity relation under the right 'resolution of vagueness' as Lewis puts it, makes the Caesar-in-command-A-bomb-worlds come closer to the actual world (the world of evaluation) than the Caesar-in-command-catapult-worlds to make the first claim true, or the other way around to make true the second. Next, Lewis claims that ordinarily we favour the 'standard resolution of vagueness' which makes the counterfactual dependence asymmetric, and the backtracking arguments mistaken. In standard cases, it is true to say that were the present different, the past would be the same. However, some 'special resolutions of vagueness' are allowed to give chance to some backtracking arguments to be right[21]. But once the need for a special resolution comes to an end, the standard resolution returns.

Now we have enough of Lewis's terminology to correct the definition of backtracking conditionals from the beginning of this section. It should pertain to a counterfactual, saying that the past would be different if the present were somehow different, that may come out true under the special resolution of its vagueness, but false under the standard resolution.

The theory of backtracking and the asymmetry of counterfactual dependence under the standard resolution is contingent. It is made for ordinary situations, and may fail in conditions like those in a time machine, or at the edge of a black hole, or in a simple world consisting of one solitary atom in a void.

5. Background 5: Arrow of Time and Various Asymmetries

Various asymmetries seem to be linked to the asymmetry of counterfactual dependence. For example, the temporal asymmetry of causation. Effects (normally) do not precede their causes. Lewis defines causation (between actual

19 Ibid. p. 33f.

20 Ibid. p. 34.

21 This kind of charitable shifts in context are common in ordinary language. Lewis explains that in his famous 1979b.

events) in terms of counterfactual dependence.[22] Since the counterfactuals involved are to be taken under the standard resolution of vagueness, the asymmetry of causation is reduced to the asymmetry of dependence[23].

More important for the present topic is what Lewis called the *asymmetry of openness*: "the obscure contrast we draw between the 'open future' and the 'fixed past'. We tend to regard the future as a multitude of alternative possibilities, a 'garden of forking paths' in Borges' phrase, whereas we regard the past as a unique, settled, immutable actuality. These descriptions scarcely wear their meaning on their sleeves, yet do seem to capture some genuine and important difference between past and future."[24]

Several attempts to reduce the asymmetry of openness to some other asymmetry fail. Lewis discussed the asymmetry of epistemic possibility (the claim that we know more about the past than about the future), the asymmetry of multiple actuality (the claim that all our possible futures are equally actual), the asymmetry of indeterminism (past and present are nomically compossible with various alternative future continuations), and the asymmetry of mutability (we can change the future, but not the past). None of these four, Lewis argues, are real asymmetries.[25] What is left to try is the asymmetry of counterfactual dependence:

> In short, I suggest that the mysterious asymmetry between open future and fixed past is nothing else than the asymmetry of counterfactual dependence. The forking paths into the future — the actual one and all the rest—are the many alternative futures that would come about under various counterfactual suppositions about the present. The one actual, fixed past is the one past that would remain actual under this same range of suppositions.[26]

6. Background 6: Method for Determination of Similarity

If counterfactual dependence can be used to explain causation and openness, and thus has a very important role in Lewis's system, then he needs a proper analysis of counterfactuals. The analysis should accommodate the asymmetry of dependence, and what was said above about the backtracking and the standard resolution of vagueness. Lewis's truth conditions state that a counterfactual 'If it were the case that A, it would be the case that C' is true at the (actual or some other) world *w* iff *either* A is impossible *or* some world where both A and C are true is more similar to *w* than any world where A is true and C false.[27] A proper

22 Lewis's first version of a theory of causation is in Lewis 1973b and in the Postscript to 1973b in Lewis 1986. Later version is in Lewis 2000. Both versions use the notion of counterfactual dependence.

23 Cf. Lewis 1979a (pages 35–6 in the reprint in Lewis 1986) for details.

24 Ibid. p. 36.

25 Cf. ibid.

26 Ibid. p. 37.

27 Lewis 1973, 1973a, 1979a.

account of similarity is needed so that the truth conditions could serve Lewis's purposes. What do we know about similarity?

First, there are formal semantic constraints on the similarity relation. We will mention them briefly here without much comments, since our main concern are the informal constrains that we will consider later. We will borrow from Nute and Cross the formal presentation of Lewis's favourite system VC[28]. The model is a quadruple ‹ W, R, *l*, [ ] › where the first two and the fourth element are the usual set of worlds, an accessibility relation and a valuation function, respectively. [A] is a set of worlds where A holds. *l* is a selection function that carries information about the similarity between worlds. For a given antecedent and a world it selects the set of the most similar antecedent-worlds, i.e. l: $2^{W} \times W \rightarrow 2^{W}$ .The truth conditions for counterfactuals are: $i \in [\phi \Box\!\!\rightarrow \psi]$ iff $l([\phi], i) \subseteq [\psi]$. The constraints on similarity are these:

if $j \in l([A], i)$ then $j \in [A]$
if $i \in [A]$ then $l([A] , i) = \{i\}$
if $l([A], i)$ is empty, then $l([B], i) \cap [A]$ is also empty
if $l([A], i) \subseteq [B]$ i $l([B], i) \subseteq [A]$, then $l([A], i) = l([B], i)$
if $l([A], i) \cap [B] \neq \emptyset$, then $l([A \wedge B], i) \subseteq l([A], i)$

As we mentioned in section 3 above, Lewis thinks that there may not be the most similar antecedent-worlds, and because of that he prefers to use a three-place comparative similarity relation instead of a selection function. But we will not pay attention to that fact for two reasons. First, it has no influence on the formal properties of conditionals, i.e. we get the same system VC either way[29]. Second, expressed in terms of the selection function the system is easier to compare to other systems.

These formal constraints do not say much about similarity. A lot is left to be determined by context. This is good. As conditionals are vague, there must be an element in formal semantics that matches that fact. The informal constraints (described in the next section) that further determine similarity will also do that only partly, leaving the rest to be resolved by the context of utterance.

There are lots of things Lewis has to take care of in further determination of similarity so that it could fit in his system. First, note that there is no asymmetry built into the truth conditions. As we said, the asymmetry of counterfactual dependence is a contingent thing, and it should not be imposed *a priori*. That is why it is not decided in advance in the truth conditions that the most similar antecedent-worlds must have, for example, the same history as the actual world (the world of evaluation) before the time of the antecedent. Such a decision would make the asymmetry of dependence necessary. Also, note that in the description of similarity there should not appear any of the 'non-basic notions'. Further, since laws of nature are contingent for Lewis, it will not be decided in advance that the worlds where the actual laws of nature hold must be more similar than those

28 Nute and Cross 2002, p. 15.

29 For this formal result see Lewis 1973 on the so-called limit assumption.

with different laws. If an asymmetry of dependence is to be obtained, it should be a result of an empirical investigation of the way counterfactuals are used in ordinary situations. So rather than making in advance our decisions about what must hold of similarity and then evaluate conditionals, we should follow our natural language intuitions about which conditionals are true and which are false, and try to learn about similarity from that. Here is how Lewis describes what is achieved so far and what is his next task (by the expression 'Analysis 2' Lewis refers to the truth conditions that we mentioned at the beginning of this section):

This analysis is fully general: *A* can be a supposition of any sort. It is also extremely vague. Overall similarity among worlds is some sort of resultant of similarities and differences of many different kinds, and I have not said what system of weights or priorities should be used to squeeze these down into a single relation of overall similarity. I count that a virtue. Counterfactuals are both vague and various. Different resolutions of the vagueness of overall similarity are appropriate in different contexts.

> Analysis 2 [plus the formal constraints we listed above] is about all that can be said in full generality about counterfactuals. While not devoid of testable content—it settles some questions of logic—it does little to predict the truth values of particular counterfactuals in particular contexts. The rest of the study of counterfactuals is not fully general. Analysis 2 is only a skeleton. It must be fleshed out with an account of the appropriate similarity relation, and this will differ from context to context. Our present task is to see what sort of similarity relation can be combined with Analysis 2 to yield what I have called the standard resolution of vagueness: one that invalidates back-tracking arguments, one that yields an asymmetry of counterfactual dependence except perhaps under special circumstances.[30]

Before we proceed with the task, Lewis gives us a word of warning:

> It is all too easy to make offhand similarity judgments and then assume that they will do for all purposes. But if we respect the extreme shiftiness and context-dependence of similarity, we will not set much store by offhand judgments. We will be prepared to distinguish between the similarity relations that guide our offhand explicit judgments and those that govern our counterfactuals in various contexts.[31]

And finally, how to proceed with the task:

> The thing to do is not to start by deciding, once and for all, what we think about similarity of worlds, so that we can afterwards use these decisions to test Analysis 2. What that would test would be the combination of Analysis 2 with a foolish denial of the shiftiness of similarity. Rather, we must use what we know about the truth and falsity of counterfactuals to see if we can find some sort of similarity relation—not necessarily the first one that springs to mind—that combines with Analysis 2 to yield the proper truth conditions. It is this

30 Lewis 1979a, pages 41–2 in the reprint 1986.

31 Ibid. p. 42.

> combination that can be tested against our knowledge of counterfactuals, not Analysis 2 by itself. In looking for a combination that will stand up to the test, we must use what we know about counterfactuals to find out about the appropriate similarity relation—not the other way around.[32]

7. Background 7: small change □→ huge change

Sometimes a small change could lead to many diverse consequences and considerably change the world. Before Lewis published his 1979a, his 1973 theory was criticized several times[33] because it predicts the wrong truth value for conditionals of the form "had a certain small change occurred, the world would have been very different". The closest antecedent-and-consequent worlds must be very different from the actual world, and some antecedent-and-*not*-consequent worlds must be closer, so the conditional must be false. Fine's example of this kind is: „If Nixon had pressed the button there would have been a nuclear holocaust"[34]. From this conditional we can infer (for simplicity Lewis ties the antecedent to a particular time *t*):

Had Nixon pressed the button at *t*, the world would have been very different.

In the previous section we saw that Lewis warned us against such cases were we are governed by some previous beliefs about similarity to evaluate conditionals, rather than using conditionals to learn about similarity. Nevertheless, such examples might show that Lewis and Stalnaker chose a wrong term. Their similarity is much different from an intuitive ordinary language notion of similarity, and might be misleading because of that. To emphasize that this is a technical notion, they could have chosen a different word, for example, they could have said that the selection function picks up the *relevant*, rather than the most similar, world(s). Anyway, we will stick to Lewis's terminology and look for criteria for similarity that would give us the standard resolution of vagueness.

Lewis suggests[35] that we could learn about similarity by comparing candidates for the most similar antecedent worlds. So let us consider these worlds:

w_0 The actual world. Suppose that w_0 is deterministic, that in it Nixon didn't press the button and a holocaust never occurs. Suppose that the infamous button really exists, that the mechanism for launching nuclear missiles is in perfect order, and cannot be stopped once the button is pressed. Because of that we want (1) to be true according to our criteria of similarity.

As Lewis does not believe that the asymmetries discussed here could be explained through indeterminism[36], he decided to consider our world as

32 Ibid. p. 43.

33 If you need references Lewis listed them in 1986 p. 43.

34 Fine 1975, p. 452.

35 Section "The Future Similarity Objection" in Lewis 1979a.

36 1986 p.37.

deterministic. His definition of determinism (a modified idea of Montague[37]) goes like this: "A *deterministic* system of laws is one such that, whenever two possible worlds both obey the laws perfectly, then either they are exactly alike throughout all of time, or else they are not exactly alike through any stretch of time. They are alike always or never. They do not diverge, matching perfectly in their initial segments but not thereafter; neither do they converge."[38]

w_1 Until shortly before *t*, w_1 is exactly like w_0 . The two match perfectly in every detail of particular fact. Shortly before *t* the spatio-temporal region of perfect match comes to an end as w_1 and w_0 begin to diverge. The deterministic laws of w_0 are violated at w_1 in some 'simple, localized, inconspicuous way'. A 'tiny' miracle takes place. Perhaps a few extra neurons fire in some corner of Nixon's brain. As a result of this, Nixon presses the button. With no further miracles events take their lawful course and the two worlds w_1 and w_0 go their separate ways. The holocaust takes place. From that point on, the two worlds are not even approximately similar in matters of particular fact.

Laws are for Lewis exceptionless regularities, so there is no breaking of laws in w_1. There is breaking of laws of w_0 that happen in w_1. Hence the 'miracle' in w_1 is a miracle relative to w_0, not to w_1.

w_2 This is a world completely free of miracles: the deterministic laws of w_0 are obeyed perfectly. However, w_2 differs from w_0 in that Nixon pressed the button. By definition of determinism, w_2 and w_0 are alike always or alike never, and they are not alike always. Therefore, they are not exactly alike through any stretch of time.

w_3 This world begins like w_1. Until shortly before *t*, w_3 is exactly like w_0 . Then a tiny miracle takes place, permitting divergence. Nixon presses the button at *t*. But there is no holocaust, because soon after *t* a second tiny miracle takes place, just as simple and localized and inconspicuous as the first. The fatal signal vanishes on its way from the button to the rockets. Thereafter events at w_3 take their lawful course. At least for a while, worlds w_0 and w_3 remain very closely similar in matters of particular fact. But they are no longer exactly alike. The holocaust has been prevented, but Nixon's deed has left its mark on the world w_3.

w_4 This world begins like w_1 and w_3. There is perfect match with w_0 until shortly before *t*, there is a tiny divergence miracle, the button is pressed. But there is a wide-spread and complicated and diverse second miracle after *t*. It not only prevents the holocaust but also removes all traces of Nixon's button-pressing. The cover-up job is miraculously perfect. Of course the fatal signal vanishes, just as at w_3, but there is much more. The fingerprint vanishes, and the sweat returns to Nixon's fingertip. Nixon's nerves are soothed, his memories are falsified, and so he feels no

37 Montague 1962.

38 Lewis op. cit.

> need of the extra martini. The click on the tape is replaced by innocent noises. The receding light waves cease to bear their incriminating images. The wire cools down, and not by heating its surroundings in the ordinary way. And so on, and on, and on. Not only are there no traces that any human detective could read; in every detail of particular fact, however minute, it is just as if the button-pressing had never been. The worlds w_4 and w_0 reconverge. They are exactly alike again soon after *t*.

Each of the worlds w_{1-4} represents a group of worlds. Which one are we going to proclaim the most similar to the actual world? According to the criteria explained in the previous section, we have to choose the one that will give us the right truth value for the conditional (1). Obviously, it is the group represented by w_1. w_2 also has very different future and it makes (1) true, but at the expense of making true all sorts of backtracking conditionals, so it is not the right choice.

Comparing w_1 and w_2 Lewis concludes that for the similarity we seek a lot of perfect match of particular fact is worth a little miracle. Comparing w_1 and w_3 we learn that close but approximate match of particular fact is not worth even a little miracle. Taking the two lessons together, we learn that perfect match of particular fact counts for much more than imperfect match. The lesson from comparing w_1 and w_4 is that perfect match of particular fact even through the entire future is not worth a big, widespread, diverse miracle. Taking that and the lesson of w_2 together, we learn that avoidance of big miracles counts for much more than avoidance of little miracles. With these lessons Lewis can finally formulate the criteria he could add to his truth conditions to obtain the standard resolution of vagueness:

a) It is of the first importance to avoid big, widespread, diverse violations of law.
b) It is of the second importance to maximize the spatio-temporal region throughout which perfect match of particular fact prevails.
c) It is of the third importance to avoid even small, localized, simple violations of law.
d) It is of little or no importance to secure approximate similarity of particular fact, even in matters that concern us greatly.

The order is important. For example, if we switch (a) and (b), w_4 type of worlds will become the most similar; switching (b) and (c) will choose $w_{3,}$ etc.

Note that no 'non-basic' notions occur in (a)-(d). The criteria are given in terms of laws and perfect match of particular facts, which can be regarded as supervening on the arrangement of qualities, so they fit Lewis's system.

Are there more types of worlds we should have considered? Lewis said that there were other candidates, but that they teach us nothing new[39].

39 1986 p. 47.

8. Transition Period and New Candidates for the Most Similar World

But is that so? We think that we can bring (at least) two more candidates that can teach us something about similarity, the second of which we will discuss in more details.

Let us consider the familiar example with Goodman's match m. Let A=the match m is struck, C= the match m lights, and let both A and C be false. Let B_1=m is dry, B_2=m is well made, B_3=oxygen enough is present, and let us add a relevant law of nature, B_4 = All dry, well made matches light when struck in the presence of oxygen. Suppose B_{1-4} are true. Consider

(2) Had m been struck, it would have lit. (A□→C)

B_{1-4} form what Goodman called the set of relevant background truths, which, together with the antecedent, entail the consequent. Had he been able to formulate his truth conditions, they would tell us that (2) is true. We prefer to call the relevant background propositions the *explanation* of the truth of (2).[40] They give us the *reason* why (2) is true.

Now consider the class of worlds typified by w':

w' This is a world at which A and the B's are true.

C is true at w', so if such worlds were proclaimed more similar to the actual world than any other A-worlds, Lewis's truth conditions would say that (2) is true. In a similar way we could describe a class of worlds that would make Kit Fine's (1) true. If the B's are true propositions describing the state of each part of the bombing mechanism and the target places, dispositions of the bombs, plus the relevant laws of nature, and if A were the antecedent of (1), and if w'-type worlds were the most similar to w_0, (1) would be true according to Lewis's truth conditions, as it should be.

Next, let us consider the class of worlds typified by w:

w Until *t*, w is exactly like w_0. The two match perfectly in every detail of particular fact. At *t* the spatio-temporal region of perfect match comes to an end as w and w_0 begin to diverge. An abrupt change happens that makes the antecedent true. w still matches w_0 in particular fact as much as the antecedent being true permits it to. With no further miracles events take their lawful course and the two worlds w_1 and w_0 go their separate ways. The consequent becomes true at *t* or after.

Taking w-like worlds as the most similar would make (1) true, and, if we take *t* to be the antecedent time of (2), then (2) is true as well, *comme il faut*.

We went into the details of Lewis's method of determining similarity that would give us the standard resolution of vagueness, and we see no reason whatsoever to give advantage to w_1 over w' or w. Of course, (a)-(d) give

40 For the reasons explained in Djordjevic 2005, 2013, and Ostojic 2016.

advantage to w_1, but it is exactly (a)-(d) that we question when we claim that there are more candidates for the most similar world; rules like (a)-(d) are to be formulated after we are sure about the best candidates, not before.

What could Lewis say against w' or w?

w' does not go against Lewis's method for informal constraints on similarity that lead to the standard resolution of vagueness, nor against his truth conditions. However, it does go against his formal constraints that we listed in section 6. To explain why, we will use some terminology developed in Nute and Cross 2002. They classify theories of counterfactuals like Lewis's and Stalnaker's as *minimal change* theories, which roughly means that these theories evaluate conditionals by evaluating the consequent in the antecedent worlds that in a relevant way differ minimally from the actual world, only insofar as the antecedent being true permits it to. Thus according to this type of theories when we evaluate (2), we consider worlds that are just like the actual world in many respects that have nothing to do with the match m. "*Just* like [the actual world]? Worlds resembling [the actual world] in respect of the number of sardines in the Atlantic, the average colour of alpine lilies in Tibet, and the salinity of the smallest rock pool in Iceland? "[41] In evaluating (2), Gabbay would refuse to deal with sardines and lilies, and in general he rejects the minimal change approach. Here is what he says:

> "For example, if I say 'If I were the president I would have withdrawn from the east', I mean to say that, the political situation being the same, B follows from A ... So in order to falsify my statement, one has to present a possible world where both the political situation is the same and I am president but where I do not withdraw from the east. We do not care whether in that world a Mr Smith has a beard or not, because this is not relevant to my statement."[42]

To rule out Mr. Smith and in general to rule out irrelevant stuff, Gabbay introduces a three place operator that takes into account both antecedents and consequents. Nute and Cross present his system in terms of a selection function that takes three arguments, the world of evaluation, the antecedent and the consequent. A conditional is true if its consequent is true in all the selected worlds. But unlike the theories that use the two-place selection function (antecedent and world of evaluation, as in minimal change theories), Gabbay's theory would not evaluate different consequents in the same set of worlds even when the antecedents are the same. For example

(3) Had m been struck, I would have heard the characteristic sound of a match being struck

Gabbay's selection function would pick up different worlds where m is struck for (2) and for (3), since some things are important only for one of the two conditionals and irrelevant for the other, my hearing abilities for example, or whether I am awake or asleep. Nute and Cross classify Gabbay's theory as a

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41 Bennett 2003 p. 307.

42 Gabbay 1972 p. 98.

maximal change theory[43], meaning that the selected worlds must resemble the actual world only in some minimal respects, and otherwise can differ from it in any degree whatever.

Maximal change theories give much weaker logic than the minimal change theories do. Most of Lewis's formal constraints we listed in the section 6 do not hold for Gabbay's selection function. The way we described w' in terms of an explanation of a conditional being true would require a three-place rather than a two-place selection function. For example, explanations of why (2) is true and why (3) is true are quite different, the B's expressing these explanations would be different, and the w'– type worlds for (2) and (3) would be different, even though they have the same antecedent. Thus choosing w'– type worlds as the most similar would go against Lewis's formal semantics.

Now we can answer the question what could Lewis say against w'? He could mention two reasons. The first is just shown incompatibility with his formal system. The second is that the notion of explanation involved in the description of w' would be hard to fit in the order of Lewis's reductive system. Maybe explanation could be reduced to arrangements of qualities, but not at this stage of reduction, before even counterfactuals and causation are analyzed.

We expect that these points could be of interest, relying on this calculation: there are people who (partly) reject Lewis's system, and people who reject his formal semantics for counterfactuals; the two groups may well overlap; in the intersection we expect to find people who like Lewis's story about the standard resolution of vagueness (which is impressive, especially taken together with the story about asymmetries, whether one accepts it or not). Such people may find it useful to know that the method made for the standard resolution is by itself compatible with other formal systems for conditionals and with the use of the non-basic notions including the notion of explanation.

What could Lewis say against w? Unfortunately, not much can be found in Lewis's writings that is explicitly relevant for the question. w differs from w_1 in not having the transition period. Lewis's method of following our linguistic practice to learn about similarity doesn't seem to favour w_1. What is it in the way we use conditionals that requires transition periods? Let us see what we can find about these questions in Lewis's paper. (Italics added; (2) and (2*) from this citation can be understood as referring to our w_1 and w.)

(2) *w is exactly like our actual world at all times before a transition period beginning shortly before t.*

...

We *need* the transition period, and *should resist any temptation* to replace (2) by the simpler and stronger

(2*) *w* is exactly like our actual world at all times before *t* .

(2*) makes for abrupt discontinuities. Right up to *t*, the match was stationary and a foot away from the striking surface. If it had been struck at *t*, would it have

43 Nute and Cross section 1.6.

> travelled a foot in no time at all? No; we *should* sacrifice the independence of the immediate past to provide an *orderly* transition from actual past to counterfactual present and future. [44]

Why should we resist the temptation? So that the match does not travel in no time at all? Why is that important? What is it in our linguistic practice that imposes such backtracking worries on us? Why think about the things that should have happened to lawfully lead to the antecedent? Not clear. A miracle is involved anyway, so why is traveling in no time a problem? Maybe because we should sacrifice the independence of the immediate past to provide an orderly transition. But why should we do that? Not clear either. And in what sense is the transition *orderly* if it involves a miracle? Maybe it is orderly because in w_1 everything happens according to the laws of w_0 after the miracle. But the same happens in w after the abrupt change, so w is not less orderly in that sense. It seems that the involvement of the transition period is not sufficiently motivated nor explained.

9. What is Wrong with Lewis's World?

We have not been able to find in Lewis's method any reasons to favour w_1 over w. Maybe one could say that this is because we haven't yet considered other parts of his system, like the rest of the story about asymmetries and its consequences to the theory of causation. Counting w_1 – type worlds as the most similar fits very nicely in the rest of the system. We will consider such topics in the following sections. But even before that, we could say that favouring w_1-type worlds because they fit the system looks like fixing the results of Lewis's method for the benefit of his system. Nevertheless, we do not think that this fixing must be bad. Let us put the things this way: if neither w– nor w_1-type worlds make any problem, and if w_1-worlds, unlike w-worlds, fit into the rest of the system, then let the spoils go to the victor and let us proclaim w_1-worlds the most similar. We have nothing against that. However, we do believe that w_1-type worlds make troubles that w-type do not, and we do not believe that w-worlds cannot fit into the system.

Let us begin with a worry whether Lewis's theory involving small miracles is general enough. In section 6 we cited him claiming that his Analysis 2, i.e. his truth conditions, are fully general and that the antecedent can be a supposition of any sort. But with the addition of his informal criteria (a)-(d), he might lose the generality. Consider the conditional (with an 'exaggerating' antecedent):

(4) Had each city whose name starts with 'A' turned into its nearest city whose name starts with 'B' as it will be in 1234 years, then grandpa's eyebrows would have raised in surprise.

Hard to imagine a small miracle that would make the antecedent true.

44 Lewis 1979a (p. 39f in the reprint 1986).

This problem is related to the notion of small miracles, and the next two are about the transition period. Let us consider some worries that Lewis found himself. In the continuation to the previous citation, he said:

> That [we need small miracles and transition periods] is not to say, however, that the immediate past depends on the present in any very definite way. There may be a variety of ways the transition might go, hence there may be no true counterfactuals that say in any detail how the immediate past would be if the present were different. I hope not, since if there were a definite and detailed dependence, it would be hard for me to say why some of this dependence should not be interpreted—wrongly, of course—as backward causation over short intervals of time in cases that are not at all extraordinary.

The worry Lewis points to is that, since he sacrificed the independence of the immediate past, some backtracking counterfactuals about the transition period threaten to turn out to be true. Let D be a proposition saying that an event *d* occurred in the transition period. Would then a backtracking counterfactual A□→D be true? Lewis said he hoped that would not happen, because among the most similar worlds there are lots of worlds with small miracles that lead to the antecedent, and there seem to be no reason to suppose that *d* must happen in *all* of these worlds. Hence there is no reason to suppose that A□→D is true. What would be Lewis's problem if some such conditional turned out to be true? If that happened, it would be under the standard resolution of vagueness (which is assumed in his theory of causation), and it would mean that the lack of the antecedent-event is a backward cause of the lack of the earlier event *d*. But we explained on what basis Lewis hoped that that would not happen.

Did Lewis too optimistically believe that no such D could ever be found? He might well bite the bullet and accept very general backtracking conditionals of the form:

Had an actual event not occurred, its immediate past would have been different.

because they need not be harmful to his system – as Lewis said he hopped, maybe no counterfactual about concrete particular events follows. However, it seems that some less general examples might be true, for example:

(5) Had m been struck, it would have to have been out of the box some time before.

Assuming that the worlds where matches are struck while still in the box are usually not to be considered as most similar, and since in the w_1-type worlds matches resist the temptation to travel in no time, (5) seems to be true according to Lewis's theory, and seems to bring the problem of backward causation (that the match not being struck caused that it stayed in the box earlier).

To point to another type of problems involving the transition period, let us note that no small miracle could have only one effect (the antecedent-event). Each small miracle must be a link of many causal chains of events, *some* of which include the antecedent-event, but some of which do not. What happens with the chains that miss the antecedent event? They lead to some events that have nothing to do with the conditional in question, and they spread their (irrelevant) effects throughout the future of w_1. It may happen that some of these chains would meet sometimes, i.e. they might have a common effect sometime in the future. But that is irrelevant also, except maybe in one case. What if some of those irrelevant chains meets the relevant chain supposed to go the way small-miracle-antecedent-consequent *before* the consequent-event? What if it somehow cuts the connection between the antecedent and the consequent? For example, a few extra neurons fire in some corner of Nixon's brain (small miracle), and as a result he decides to press the button. While moving his hand to do so, he incidentally spilt some gin from his glass, affecting the mechanism linking the button with the bombs. He presses the button. No bombs are launched. No holocaust occurs. How do we (or Lewis) *know* that in *none* of the most similar w_1-type worlds *no* 'side' effects of the small miracle could *possibly* cut the connection between the antecedent-event and the consequent-event? We would have to know exactly that to accept w_1 as the most similar. If it is possible that our scenario happens in a most similar world, then it does happen in some of the most similar worlds (of course, not in all of them). Consequently, both (1) and its opposite:

Had Nixon pressed the button at *t*, the world would *not* have been very different.

turn out to be false.

In evaluating a conditional, we look for the antecedent worlds where the relevant conditions from the actual world hold, like the match m being dry, well made etc., or the button and the launching mechanism being in the same state as they are in the actual world. To ensure that the relevant conditions hold in the most similar antecedent worlds, Lewis keeps the history of those worlds identical to the actual history for as long as possible. But that is not long enough to ensure that that the relevant conditions will hold for as long as we need them in *all* of the chosen antecedent-worlds (in our scenario the mechanism was not in the working order long enough). To keep the transition period and w_1-worlds as the most similar, Lewis would have to somehow exclude the possibility of a spoiler-world among the most similar worlds. That seems to be too difficult a task. It would lead to some awful Goodman-like circularities, that would probably evade any reduction to the arrangements of qualities at this place in Lewis's reductionist system.

However, rather than deal with such irrelevant issues, we believe that it would be better to drop the transition period and small miracles altogether.

10. Background 8: More Asymmetries

Lewis finds it important to emphasize that, like the truth conditions and the formal constraints on similarity, the informal rules for standard resolution (a)-(d) also do not impose any asymmetry. So the asymmetry of counterfactual dependence stems from another source. Lewis finds it in the asymmetry of miracles[45]. Both small and big miracles can lead to divergence between two

45 Ibid. p. 47f.

worlds with the same history, one of which is deterministic, the other acting as deterministic at all times except during the miracles, like w_0 and w_1. But not both types of miracles can lead to convergence, i.e. to the perfect match of particular fact. Small miracles can lead at beast to approximate match. It is this difference between the two types of miracles that brings the asymmetry of counterfactual dependence.

Before we go on, let us make clear why the rules (a)-(d) are symmetric. Note that if a world, call it w_5, which is like w_1 up to some time after divergence from w_0, could converge back to w_0 due to another *small* miracle, then the rules (a)-(d) would consider w_5 more similar to w_0 than w_1. Then the asymmetry of counterfactuals dependence would be lost. Therefore, the asymmetry of counterfactual dependence is not built into (a)-(d), but presupposes that small miracles in worlds like ours cannot lead to convergence. We can imagine a world where that presupposition fails, for example a world consisting of a solitary atom in a void. This would be a world without asymmetry of dependence. That also reminds us that Lewis's thesis about this asymmetry is contingent, meant for the worlds like ours.

Now, where does the asymmetry of miracles come from? Lewis finds its source in the asymmetry of *overdetermination*[46]. Let us say that a *determinant* of a fact is a minimal set of conditions jointly sufficient, given the laws of nature, for the fact in question. A fact having more than one determinant is said to be overdetermined. Ordinarily facts in our world have one or few essentially different determinants that precede the fact, and very many determinants in the future, like the spherical concentric waves, which expand around the place in water where a stone fell, having one determinant in the past (the stone's influence in the center), and countless tiny samples of each of the waves being the future determinants of what happened in the center. The asymmetry of overdetermination (few past and many future determinants) explains the asymmetry of miracles, i.e. why divergence is 'easy' and convergence is 'hard', or why a small miracle is sufficient for divergence and a huge number of small miracles (or one big miracle) is needed for convergence. Again, the asymmetry of overdetermination is contingent.

11. Abrupt Change and Reduction of Asymmetries

If what we said so far is right, we opened some obvious questions, each of them posing a task that is now in front of us. Here we will be able to deal with some of them. Let us see what they are. We rejected transition periods, and with them we have to reject the small miracles. So we lose the asymmetry of miracles as a link between the asymmetry of overdetermination and the asymmetry of counterfactual dependence. Instead of Lewis's small miracles we introduced a different kind of miracles, an abrupt 'non-Leibnizian' instantaneous change. We need to determine that notion in such a way to regain a link between the

46 Ibid. p. 48f.

asymmetries of overdetermination and dependence. Even if that could be done, we are not sure whether the system could overcome all other challenges. Of course, the task is made more complicated by Elga's argumentation[47] that even with complicated worlds like ours convergence is possible via a small miracle. Another task, which we will leave undone or left for another occasion, is to show the implications of our argumentation to other theories that use the notion of transition period, like Barry Loewer's[48].

Let us explain the problem with the missing link. Small miracles, Lewis believed, cannot bring convergence, which makes them asymmetric to the big miracles. Our abrupt change, without any qualifications, can do anything, including convergence to the actual or any other world whatsoever. We need to tame it somehow, so that it fits several purposes: we need to specify a kind of abrupt changes that fits Lewis's method of determining the similarity relation, and would keep the 'old', previously established asymmetries of causation, counterfactual dependence, and openness, but one that would be asymmetric to the big miracles, thus bringing back the link to the asymmetry of overdetermination, or to find another link to it. If we could not do all that, we would have to regretfully abandon Lewis's fine chain of reductions of asymmetries. In that case we would keep the worlds with the abrupt change and no transition as the most similar since they fit Lewis's method for determination of similarity. Or we could reject his formal system of counterfactuals, still keep his method, and switch to Gabbay's system or some other. In both cases we could still have an explanation of the asymmetries of openness and counterfactual dependence. However, that explanation would be a mere report of our linguistic practice. Lewis wanted to achieve more. He wanted to find a deeper root of the asymmetries that would link our linguistic practice to some important feature of the real world. The descriptions of the unclear asymmetry of openness and the asymmetry of counterfactual dependence, which are reports of the way we speak, have their root, according to Lewis, in the metaphysical truth about our world, namely the asymmetry of overdetermination.

But we don't give up hope. We think we have a notion of a miracle that brings back the missing link. The hope is based, among other things, on the word 'minimal' that occurs in the definition of a *determinant* (a minimal set of conditions jointly sufficient, given the laws of nature, for the fact in question). Let us assume that antecedents and consequents are claims about occurrences of events (in Lewis's sense[49]). Let us understand a determinant of an event in an analogous way to the determinant of a fact. Let a miracle that happens in w be an abrupt change consisting only in what is needed to bring about a determinant for the antecedent-event. Let 'small miracles' occurring in (a)-(d) and in the description of w_{1-4} be replaced by the miracles just described. That would make Lewis's w_1 turn into our w, and w would be chosen as the most similar. But

47 Elga 2000.

48 Loewer 2007.

49 Cf. Lewis 1986a.

that would happen only if our restricted abrupt change were asymmetric to big miracles. We leave the notion of big miracles much as it is, but we add that it could consist not only of a huge number of small miracles, but could consist also of a huge number of restricted abrupt changes. If a big miracle were to lead to a convergence of w to w_0, (at least) one of these smaller miracles would be needed to annihilate each future determinant of the antecedent-event. The most important question is whether our miracle can lead to convergence? If properly restricted, it should not. We tied our notion of a miracle to the notions of events and determinants, and to restrict it somehow, we put a restriction on events. We will say that our abrupt change makes instantaneously true a determinant of an event that does *not* bring a huge number of spread out and diverse unlawful changes; and it does not bring any other changes (so this is still a minimal change theory, in the sense of Nute and Cross).

Is this cheating? We do not think so. Had we defined our miracles as a change too small to lead to convergence, that would have been cheating. But we just proposed a vague not-quite-clear definition in the same manner Lewis did when he described his small and big miracles. Small miracles are "simple, localized, inconspicuous". Big miracles are described pretty much as being 'not small'. They are "big, widespread, diverse, complicated" heap of a huge number of small miracles. If that is good enough, then we can define our miracles as 'not big' (that is what our definition practically amounts to).

Replacing small miracles in (a)-(d) and in the description of w_{1-4} with our miracles would bring the same results. w_1 is the most similar to w_0, but relative to a simple world consisting of one atom it is w_3 that would turn out to be the most similar, since the second miracle would lead it to convergence to that simple world. We didn't put any non-basic notions into (a)-(d), and similarity is still reducible to the arrangements of qualities. It seems that we recovered the link to the asymmetry of overdetermination and glued the system back where we broke it.

But there are more problems. Maybe our solution would work for many ordinary counterfactuals, but not for the conditional (4) (with an 'exaggeration'), or other conditionals of the form (huge change) $\Box\!\!\rightarrow$ (some change). We believe we solved the problems caused by the notion of transition period; but the problem (4), caused by the smallness of small miracles, reappeared in our modification of the theory, caused by the smallness of our miracles, that is, by the smallness of the events we use in the definition of our miracles. We regret that to this and to Elga's problem we currently have no comment.

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