Acta Anal (2011) 26:95–114
DOI 10.1007/s12136-009-0070-4

Lewis' Reduction of Modality

Sandy Berkovski

Received: 30 July 2009 / Accepted: 24 October 2009 / Published online: 12 November 2009

Abstract I start by reconsidering two familiar arguments against modal realism. The argument from epistemology relates to the issue whether we can infer the existence of concrete objects by a priori means. The argument from pragmatics purports to refute the analogy between the indispensability of possible worlds and the indispensability of unobserved entities in physical science and of numbers in mathematics. Then I present two novel objections. One focusses on the obscurity of the notion of isolation required by modal realism. The other stresses the arbitrary nature of the rules governing the behaviour of Lewisean universes. All four objections attack the reductive analysis of modality that is supposed to be the chief merit of modal realism.

Keywords Modal realism · Spacetime · Isolation · Contingency · Necessity · David Lewis

1

In this paper I want to explore the difficulties posed by the reduction of modal notions for Lewis' metaphysics of possible worlds. The idea of Lewis' worlds is a familiar one. The actual world is identified with our spatiotemporal universe. There are other universes spatiotemporally disconnected from ours. These universes are merely possible worlds. The universes satisfy the requirement of maximality: every spatiotemporal part of a given world is connected to its every other part and no part of the world is disconnected from any other part.

S. Berkovski (✉)
Department of Philosophy, Bilkent University, Ankara 06800, Turkey
e-mail: sandy.berkovski@gmail.com

Thus, to say that X is merely possible is to say that it is located in another universe, and to say that X is actual is to say that it is located in our universe. A complication arises with necessarily existing entities, such as sets, which are not spatiotemporal. It is resolved by further distinguishing between three different senses of 'being in a world'.[1] Another complication is with the existence of spirits. Lewis wishes to allow the worlds containing spirits—perhaps in contrast to the actual world. Those spirits have to be at least temporal. For if not, there would not be any reason to assign a spirit X to the world w rather than to the world $u \neq w$. On the other hand, it is clear that they are contingent and are, therefore, nothing like sets which are represented at every world. Some theorists, however, regard the claim about spirits as simply incoherent.[2]

The chief ambition and merit of modal realism, as contrasted with other versions of realism about possible worlds, is its reduction of modal notions. The success of the reduction entails that for any statement S_1 involving modal locutions there is a statement S_2 where modal locutions are replaced by possible-worlds locutions, and for every statement S_2 there is a statement S_3 where possible-worlds locutions are replaced by spacetime locutions, where the content of S_1 is given by the content of S_2, and the content of S_2 is given by the content of S_3. Thus, for example, let S_1 be 'Grass could possibly be blue.' Then S_2 is 'There is a possible world w such that grass is blue in w', and S_3 is 'There is a spatiotemporally isolated (spatiotemporal) universe w such that grass is blue in w.' In the outcome we dispense with the modal vocabulary. All that is required for adequately expressing modal locutions is the spacetime vocabulary. The clauses for necessity and contingency may therefore be put as follows:

> S is necessarily true iff S is true in every spatiotemporal universe.
> S is contingently true iff S is true in our spatiotemporal universe and there is a spatiotemporal universe disconnected from ours where S is false.

I will argue that the reduction of modality turns out to be the source of several difficult objections to the metaphysics of modal realism. The plan is as follows. In Sections 2 and 3 I elaborate the details of two familiar arguments questioning the epistemology and pragmatic virtues of Lewis' theory. These arguments exploit modal reduction, but none of them is quite decisive. In Sections 4 and 5 I ask whether Lewis provided us with an adequate understanding of intra-world spatiotemporal connectedness and cross-world isolation. I argue that, although there may be an acceptable coherent notion of the former, there can be no notion of the latter acceptable to the modal realist. In Section 6 I argue that precisely because of modal reduction the plurality of worlds is necessarily governed by a physical law. Finally, in Section 7 I address modifications of modal realism intended to deal with some of the difficulties raised earlier.

[1] See Lewis (1986:94–6).
[2] See Lewis (1986:2,73) and Bigelow and Pargetter (1987:106–7).

2

Speaking generally, given a certain philosophical doctrine, two classes of objections may be distinguished. They may be labelled 'formal' and 'philosophical', respectively. Formal objections aim at uncovering a contradiction within the doctrine. Thus, Russell's paradox constituted such an objection to Frege's programme in *Grundgesetze*, Gödel's First theorem generated a formal objection to Hilbert's programme, whilst Simmel formally refuted Nietzsche's theory of eternal return. In contrast, Poincaré's misgivings about logicism and formalism belong squarely in the class of philosophical objections. Those objections, far more numerous than the objections of the first sort, question the doctrine's plausibility and the soundness of its arguments, leaving aside the issue of its coherence. The essence of the objections belonging to the second class is summarised by Russell who initially regarded Leibniz' *Monadology* as 'a fantastic fairy tale, coherent perhaps, but wholly arbitrary.'[3]

The debate in the metaphysics of possible worlds produced at least one notable formal objection, the Kaplan-Peacocke paradox, and recently there were attempts to find others. The objections I consider here are all of the philosophical sort. One familiar argument against modal realism raises epistemological concerns. The guiding thought is that we cannot have any a priori information about the existence of material bodies.[4] There must be something amiss in the modal realist ambition to discover isolated universes in the solitude of his study. Another form of the same objection will focus on causality. If a subject knows that X exists, then he must stand in a causal relation to X.

The modal realist is aware of this kind of objection.[5] His response is essentially that the *necessary* existence of possible worlds is known a priori, whereas the *contingent* existence of material objects is known empirically. More specifically, consider a material object X. The modal realist reply to the objection from a priori knowledge can be summarised as follows:

> If X is merely possible, then the facts about X are knowable (if at all) a priori. If X is actual, then the facts about X are knowable (if at all) empirically. (1)

And to the objection from causal knowledge he replies thus:

> If X is merely possible, then the facts about X are not known causally. Only if X is actual the facts about X are known causally (if the causal theory of knowledge is correct). (2)

[3] See Russell (1937:xvii).
[4] See e.g. Stalnaker (1996).
[5] See Lewis (1986:112).

The common trend is clear: we should not expect merely possible physical entities to be known in the same way as actual ones.

However, such a response does not cohere with the modal realist's own view. It is convincing only in so far as we believe in the irreducible properties of necessity and actuality which have an impact on our mode of knowing. But according to modal realism, to be merely possible is nothing but to be spatiotemporally disconnected from our universe (in the special case of beings like spirits, to be temporally disconnected). So the conditionals in (2) are question-begging: of course, one cannot causally know facts about spatiotemporally isolated objects. Yet, the original worry was whether *anything* is, therefore, knowable about these objects. Similarly, the conditionals (1) can work if we make the same assumption: that actual material objects and merely possible material objects are known in two different ways. Given that mere possibility is entirely a matter of spatiotemporal isolation, we are still puzzled as to why there must be odd material objects necessarily knowable *a priori* (if knowable at all).

The modal realist response may also be interpreted as drawing a contrast between knowing necessary truths and knowing contingent truths. It is the knowledge of contingent truths that is empirical and which, among other things, may require perception. But the knowledge of necessary may well be a priori or perhaps based on considerations of utility. Such a response overlooks the issue of the ontological debate. The issue at stake is the nature of possible worlds. Firstly, both the modal realist and the objector could certainly agree, for instance, on the form of logical knowledge or mathematical knowledge—that is, on the form of knowledge of logical space. Their agreement will result from independent assumptions about logic or mathematics. But the attempt to put the distinction between knowledge of necessities and knowledge of contingencies at the top and derive from it conclusions about logical or mathematical knowledge should fail. The reason is the same: the modal realist analyses necessary truths as truths in all spatiotemporally isolated universes. And then it seems inexplicable how knowledge about those universes is safeguarded. Secondly, the sides can agree on the existence of certain entities called 'possible worlds' that are indispensable for the modal discourse. What the sides cannot agree on is why possible worlds are to be regarded as spatiotemporal universes. On the lips of the epistemic objector this turns into a doubt about discovering the spatiotemporal nature of possible worlds in the solitude of one's study.

The epistemic objector is, therefore, not committed to denying the existence of modal realist universes. Rather, *if* these universes exist, *then* the modal realist account of establishing their existence cannot be right—due precisely to their spatiotemporal nature. Now, it may be noted that epistemological difficulties plague a view which treats possible worlds as abstract objects. Supposing that epistemic access to abstract objects is no less problematic than such access to isolated spacetimes, modal realism apparently would fare no worse than its rivals in the realist camp. Moreover, one could add, if one gives up on realism altogether and converts to nominalism, epistemology might still

be a problem. As long as we are prepared to grant truth-aptness to modal discourse, we remain unclear about the mechanism of our modal knowledge. Even if we banish suspect entities, our reasoning on what could or could not be will rest on flimsy foundations. So, one could conclude with McGinn, there is no special epistemological problem with modal realism. All these problematic truths we are alleged to know a priori, and that is where the trouble is: a far more general mystery of a priori knowledge.[6]

But we may readily admit the difficulty of providing adequate modal epistemology, and still insist on the epistemological objection. With modal realism, the unique difficulty is in the perceived disharmony between the object and our professed means to gather information about the object. If, for instance, you were told of someone who can smell numbers, you are likely to refuse to take the statement literally. Numbers, if they exist, are not the kind of thing to be smelled. Nor are victories, propositions, or universities. And similarly, it seems mildly absurd to employ modal reasoning in discoveries of spatiotemporally isolated objects. Assuming that Lewisian universes exist, modal reasoning is not the appropriate medium of our epistemic access to them.

So the problem posed by the epistemic objector is not in merely pointing out the absence of a coherent epistemic account. If it were such, modal realism would perhaps have challenges analogous to those encountered by ersatzisms or Forbes' modalism. Rather, the objection runs, facts about those universes cannot be discovered in the course of a reflection over a theory of modal statements. The situation is different with ersatzist worlds. These entities are adapted precisely for the task of explaining truth conditions of modal statements. They are not alien to modality, since modality has not been eliminated from their conception. It is then only too natural to expect that we know facts about them through modal reflection. And an ersatzist may further attempt to refuse providing a substantive epistemic account. Since ersatzist entities are introduced as tools of modal semantics, everything that is to be known about them is necessarily known by the same mechanism we employ to know modal truths. There would, therefore, be no problem above and beyond the problem of counterfactual reasoning.[7]

The contrast drawn by the epistemic objector is, therefore, this. With modal ersatzisms, knowledge of possible worlds may be a mystery, at least so far as modal knowledge generally is a mystery. A modal ersatzist view leaves a lacuna. With modal realism, knowledge of possible worlds (*qua* spatiotemporal universes) cannot be generated by the analysis of modal statements, however complex the details of the epistemic mechanism are. A modal realist leaves us, not with a mystery, but with false epistemology.

[6]See McGinn (1981).

[7]This move is made by neo-Fregeans in the debate over mathematical platonism. See Hale and Wright (2001:321).

3

The second promising objection relates to pragmatic considerations.[8] Here the guiding thought is that there is no parallel between believing in Lewisean universes and believing in electrons or numbers. The objection is apt, because one of the main arguments provided by Lewis in favour of modal realism—according to some, *the* main argument—appears to be a pragmatic one:

> Why believe in a plurality of worlds?—Because the hypothesis is serviceable, and that is the reason to think that it is true. … Modal realism is fruitful; that gives us good reason to believe that it is true. Lewis (1986:3–4)

The full version of the argument could be put as follows:

1. Modal statements occur in many truth-apt areas of discourse.
2. Therefore, some modal statements are true.
3. But the best analysis of modal statements is given by quantifying over possible worlds.
4. Such quantification is best understood when the worlds are spatiotemporal universes.
5. Therefore, the worlds are spatiotemporal universes.
6. Therefore, since there are worlds, there are universes spatiotemporally isolated from our universe.

One problem here is the transition from pragmatic reasons to ontological claims.[9] How can anything like simplicity or fruitfulness be used to establish the existence of any particular entity? Although many times theories taken to be true also exhibit pragmatic virtues, there is generally no guarantee that every true theory is pragmatically advantageous. Nor is there any guarantee that every pragmatically good theory is true. The problem might disappear if the concept of truth itself is given a pragmatic treatment, but that is not part of Lewis' proposal. It better not be, since the next step would be to make reality a pragmatic affair as well, which would make his position anything but realism.

However, the modal realist might try to appeal to the analogy with mathematics. The argument above should be compared to the superficially analogous indispensability argument in mathematics:

1. Mathematical statements occur in the best physical theory.
2. The best physical theory is true (or: *we* should believe it to be true, notwithstanding the chance it will be refuted in the future; let us disregard this qualification in what follows).
3. Therefore, some mathematical statements are true.

[8] Hinted in Skyrms (1976:326).

[9] This point is forcefully made by Bueno and Shalkowski (2000).

4. But some true mathematical statements contain quantification over numbers.
5. Therefore, numbers exist.

The mathematical argument is not revolting: no-one gives a mathematical realist a 'blank stare'.[10] The reason is that the truth of physical theories seem to us a fair price to pay for the existence of abstract objects, even if their existence can be denied on different grounds. Secondly, we believe that mathematics does not go beyond the area of its jurisdiction in asserting the existence of numbers. In contrast to modal realism, it does not even tell us what sort of entities numbers are. Suppose, per impossible, that one of the implications of the truth of a mathematical statement *S* were the statement 'The death penalty should be abolished'. We would then feel that there is something wrong either with *S*, or with our inference from *S* to the statement about the death penalty. This is because mathematics cannot intervene in the moral and political discourse.

By the same token, the correct analysis of modal notions seems to be an insufficient price to pay for the existence of isolated universes. And this feeling, we conjecture, is a result of our belief that the analysis of modal statements cannot establish the existence of even one material object any more than it can establish some fact of Roman history.

We could also compare the modal realist argument with a purely physicalist indispensability argument:

1. The best physical theory contains quantification over electrons.
2. The best physical theory is true (with the same qualification as above).
3. Therefore, electrons exist.

When a physical theory commits us to the belief in the existence of a certain physical entity composing material objects, it is seen as being within its rights. Physics tells us what material bodies exist in the universe and what their composition is. Modal realism asserts the existence of physical objects (since at least some possible worlds are such), yet is unable to provide a physical argument for that. Thus its credibility is low. The modal realist can only reply by arguing that modal semantics has no say on the existence of *actual* objects, yet is within its rights in judging the existence of *merely possible* objects. The response does not work for the reason already mentioned: by the modal realist's lights, mere possibility is a matter of spatiotemporal isolation. How come, then, that a theory can establish the existence of isolated universes, but not the existence of any object within our universe? This seems entirely arbitrary. The pragmatic objection is a powerful one given the weight of pragmatic considerations in Lewis (1986). But I think it does not manage to undercut modal realism completely. Calculating the costs and benefits of a

[10]Though it is of course revolting for a nominalist. The latter may well argue that mathematical practice does pose a genuine problem to be resolved through work on mathematical ontology. See Bueno and Shalkowski (2000).

particular theory is a tricky business. We must have a more straightforward objection.

4

The arguments of the previous sections have a shared theme. They pinpoint the reductive analysis of modality as the modal realist's soft underbelly. The modal realist's commitment to the reduction prevents him from giving convincing responses to both objections. I suggest we continue aiming at the same spot.

Accepting the reduction of modality should invite generally two kinds of worries: that the reduction is too restrictive with regard to what it stipulates as possible, and that it is too permissive. To the worries of the former kind belongs the notorious question of whether there could be nothing, rather than something. We envisage a possibility of nothing, yet such a possibility is to be realised at some universe, where at least that very universe, its spacetime, exists. Similarly, according to modal realism, there is no non-spatiotemporal possible world. It is not clear why any thing must of necessity be spatiotemporal—or at least temporal, as in the special case of spirits admitted to the modal-realist ontology. We must then be able to rule out a possibility of a non-spatiotemporal entity. In fact, modal realism accepts non-spatiotemporal entities, such as numbers. Those exist at every world. The question, however, may be whether there are contingent non-spatiotemporal entities. Suppose there are, and take one such entity X. Then the contingency of X is explained by saying that X exists at a world w and does not exist at $u \neq w$. Its existence at w is explained by its spatiotemporal inclusion in the spacetime of w, and analogously its non-existence at u is explained by its exclusion from the spacetime of u. But since X is not included in any spacetime by assumption, the explanation of its contingency fails.

The modal realist, I suspect, would treat the above argument as a *reductio ad absurdum*. On what right, he will ask, do we judge X's existence contingent in the first place? For that we need a world where X exists and a world where it does not. But there is no spatiotemporal world where a non-spatiotemporal X exists. Therefore, X exists necessarily. Though I am not sure how to assess this response, still the onus of proof is on the objector. He should exhibit a particular non-spatiotemporal X in order for us to take his objection seriously. Modal realism might not explain why contingency and spatiotemporality are necessarily linked together, but that by itself does not put the link in doubt.

The problem of analogous spatiotemporal relations falls in the second class of worries, that modal realism is too permissive.[11] Here the problem is in describing alternative worlds with a fixed vocabulary. Lewis puts it thus. Let the world W_r be endowed with relativistic spacetime, and the world $W_n \neq$

[11] See Lewis (1986:74–76).

W_r with Newtonian space and time. Say that a world w is *spatiotemporally interrelated* if all of its entities are mutually so related. Then the modal realist in W_r may claim that W_r is spatiotemporally interrelated and that W_n is also spatiotemporally interrelated. Now, when he calls W_n 'spatiotemporally interrelated', does he mean that it is so in the relativistic sense, or in the Newtonian sense? No problem arises in the former case. Although any two points in W_r are connected by one spatiotemporal relation, any two points in W_n of Newtonian space and time are connected by two relations, spatial and temporal. Therefore, the modal realist in W_r can legitimately assert that W_n is spatiotemporally interrelated. Yet, if he wishes to assert that the inhabitants of W_n are connected by *Newtonian* spatial and temporal relations, he cannot do so. The names for spatiotemporal relations are drawn by him from a relativistic vocabulary, that is, from the vocabulary of the spacetime theory of his own world. He must say instead that the points of W_n are connected by certain relations, and the task is to say what those relations are.

The problem, in other words, is that the modal-realist theory calls for the inhabitants of each possible world to be connected by the spatiotemporal relations $R_1, R_2, \ldots$. But the modal realist is by necessity located in some world w. The worlds other than w may have a spatiotemporal structure different from w, so that the modal realist of w will have no right to claim the 'spatiotemporal' relatedness of other worlds. There will be, in general, no world-independent univocal specification of the relations $R_1, R_2, \ldots$.

Lewis' simple solution lies in introducing 'analogical relations' that would play the role of spatiotemporal relations. Whereas they are not real spatiotemporal relations, they will be analogous to them in four respects: in being natural, pervasive, discriminating, and external.[12] He admits the idea to be a 'messy' one, and he further proposes to connect the inhabitants of each world by external relations of whatever kind.

As Lewis himself concedes, the issue of analogical relations is a difficult one. It might force a modification of modal realism. If the modal realist in W_r is to be denied the right to call the world W_n spatiotemporally interrelated, how can he believe W_n to be a *spatiotemporal* universe in the first place? Conversely, if the modal realist of W_r is granted the right to call W_n a 'spatiotemporal universe', the whole problem is dissolved. Since there are different mutually inconsistent spacetime theories, he can say that W_n is governed by one such theory, T_n (i.e. a Newtonian theory), and that it is interrelated by whatever spatiotemporal relations admissible within T_n. And if our modal realist cannot legitimately describe W_n as spatiotemporally interrelated, he cannot legitimately claim W_n to be a spatiotemporal universe. He will at most be able to say that it is analogically spatiotemporal.

[12] See Lewis (1986:76).

5

Is there a further problem? So far we have dealt only with one-half, so to speak, of the notion of Lewisean possible worlds. Each such world must be spatiotemporally *interrelated*. But, secondly, it must be spatiotemporally *isolated* from any other world. We can spell this out by saying that there is no spatiotemporal relation $\tilde{R}$ that connects two entities in distinct possible worlds. In the language of Lewis' counterpart theory we will have:

$$\forall x \forall y \forall w \forall u (Ixw \wedge Iyu \wedge \tilde{R}xy \supset w = u), \tag{3}$$

where I is the primitive relation of inclusion (later interpreted by Lewis as a mereological relation). The condition (3) represents a fundamental claim of modal realism. The sceptic has two ways of opposing it, the obtuse way and the constructive way. Obtuse objections will simply point out explanatory and other deficiencies without suggesting any incoherence, let alone any recipe for moving forward. Replies to these uninformative objections are similarly uninformative. A sample exchange could take the following form.

Obtuse objection. There is no explication of what it takes two worlds to be spatiotemporally isolated, or at any rate, what it takes the inhabitants of two distinct worlds to be so.

Reply. The modal realist is not obliged to explicate isolation. He simply denies that there is any spatiotemporal relation between the inhabitants of two distinct worlds. It is, therefore, sufficient that spatiotemporal connection is well understood.

Obtuse objection. There is no explanation why reality must consist of spatiotemporally disconnected universes, that is, why $\tilde{R}ab$ is false unless a and b are worldmates.

Reply. The explanation desired by the objector must be couched in causal terms. There clearly can be no such explanation appropriate here.

Obtuse objection. There is no theory of what kind of geometry is imposed on the reality consisting of a myriad of different spacetime structures. Does this reality have *any* geometrical structure?

Reply. The only meaningful debate is the debate about the geometrical structure of a single possible world. There is no point in debating the geometry of logical space.

Obtuse objection. Modal realism uncritically commits us to the genuineness of spatiotemporal relations (or perhaps only temporal relations). But if relationalism is true, these may well be fictions, at least in some worlds.

Reply. Where spatiotemporal relations are not genuine, a suitable paraphrase will be found.

Another reply. Relationalism is false. If it is false, then it is necessarily false. So, since it is false in our world, it is false in every other world.

For all of its shortcomings the obtuse way has its value. It advances beyond the bare scepticism of the 'incredulous stare'. It is the latter unreflective kind of scepticism which is responsible for the widespread rejection of modal realism, both among metaphysicians and other philosophers. And more interestingly, it takes the reduction of modal notions with utmost seriousness. If possible worlds are just spatiotemporal universes, the modal realist must tell a story about spacetime. Taking the clue from the obtuse objector, we may now follow up with a constructive criticism.

The question I want to ask here is to what extent the notion of spatiotemporal isolation is well understood. It is odd how little attention was paid to this issue.[13] The challenge usually comes from the opposite direction: one must be able to distinguish actual isolated universes—i.e., those described by the physical theory—from merely possible worlds. But the issue is far from trivial. Any object, however remote, is routinely conceived as being located at a certain spatial distance from us. That is why we think of it as remote in the first place. The same goes for the temporal dimension: we normally think of every event being in our past or in our future. We can at least register a certain surprise at the uncritical acceptance of disconnectedness.

How to make sense of it? Two strategies are available. On the first strategy, we are tasked with establishing the plausibility of disconnectedness. Such is the objective of King (1995) and Quinton (1962). These authors come up with complicated hypothetical scenarios that appear to be *best explained* by postulating disconnected spaces or disconnected times. The very notion of disconnectedness is, however, left uninterpreted. But so far as the modal *reduction* rests upon it, the notion cannot be treated as a primitive. The first strategy leaves, therefore, a vital lacuna.

Under the second strategy, the purpose is precisely in explicating disconnectedness. If the question is considered purely algebraically, the answer, though not trivial, is uninformative. We could say that the space X is a collection of points between which we can fix a path. For any two points $x, y \in X$ it will be determined by a continuous function $f\colon [0; 1] \to X$, where $f(0) = x$ and $f(1) = y$. Now, if there is a point u for which no f exists such that $f(x) = 0$ and $f(u) = 1$, then x and u are disconnected. And since x is connected to every other point in X, we can say that u is disconnected from X. That is all one can say: disconnectedness is obscure here, because it is postulated. No explanation is offered as to why no path is found between u and x. To

[13] A notable exception is Rosenberg (1989).

improve our understanding, we can then provide a geometrical interpretation of the notion. For example, we can take two parallel Euclidean planes A and B. Let the points x and y lie in the plane A. Then each of them can be reached from the other by drawing a line (not necessarily a straight one) itself lying in that plane. That line represents the continuous path between the points of the plane. Let the point u lie in B. Then there is no line in the plane A that connects u with either x or y.

Such is the pattern of the geometrical explication of disconnectedness. A moment of reflection shows that not much is gained by it. We have an illustration of the algebraic notion, but we are still missing the reason why u is inaccessible to x or y. And in any event, this kind of explication does not deliver the notion demanded by the modal realist. Since his possible worlds are physical spacetimes, we must search for a physical interpretation of disconnectedness.

General relativity (or GTR) might seem to offer help. It contributes two central insights to the debate. One of them is that the geometry of the world is dependent on its gravitational forces. In the presence of these forces spacetime is curved. The degree, and the sign, of the curvature affects the metric of spacetime. But the gravitational forces themselves result from a particular distribution of matter. So, in contrast to the intuitive conception, spacetime is no longer permanent and static, but is intimately linked to matter. One could, therefore, draw the conclusion that where there is no matter, understood broadly to include electromagnetic and gravitational fields, there is no spacetime either.

The second insight is altogether more controversial. The dominant cosmological solution of Einstein's field equations envisages the expanding spacetime springing into being a certain number of years ago. No longer should we postulate static space and static time, infinite and all-encompassing. Time is finite, and space is finite. If so, there is no conceptual obstacle to think about other spaces and other times. More accurately, we should speak of other *spacetimes*, so far as our own space and time are represented in GTR by a four-dimensional manifold. And therefore, the conceptual underpinning of modal realism appears to be endorsed by the best available physical theory.

However, such perception would be mistaken. GTR passes no judgement on the possibility of isolated spacetimes. Its primary concern is with the *local* geometry of spacetime. It is charged with describing the influence of matter on the geometrical features of the world. As far as GTR is concerned, what happens at infinity, far away from matter, is given to negotiation. It may be that spacetime flattens out there, and the curvature becomes zero. Or it may be that the world has a natural curvature, and its geometry is either hyperbolic or elliptic. The second option itself splits in two. It may be that the global curvature of the spacetime is its fundamental property, not subject to any kind of further causal explanation. Or it may be that it is caused by chunks of matter acting on the universe from the fifth dimension. We will then have a situation analogous to Poincaré's thought-experiment of a heated sphere: whereas inhabitants of our universe see the whole of spacetime as curved, to

the observer outside the universe its curvature is caused by the behaviour of matter.

The complaint voiced so far has been factual. As a matter of fact, we say, there is no readily available interpretation of disconnectedness. Now the question is, could there be such an interpretation *in principle*? Suppose we equip modal realism with a theory T which provides us with the desired interpretation of disconnectedness. What would be the status of T itself? It could not be a purely mathematical theory, so far as possible worlds are not mathematical abstractions, but physical space-times. So, per above, it is a physical theory. But if it is a physical theory, then at least that part of it which deals with disconnectedness is not necessary, but contingent: disconnectedness is treated as a physical phenomenon. With interpretation will come an attempt of explanation. The theory T will have to say why two worlds are disconnected. But so far as T is a physical theory, the 'reason' two worlds are disconnected will be contingent.

Plainly that would be an unacceptable result for the modal realist. I do not know what he can say in response to the lack of explication. But he may still fasten on our ambition to explain. We were wrong, he might claim, in demanding a physical explanation of disconnectedness. Any such explanation should be available for intra-world phenomena, for the events occurring within one world. The objector here demands an explanation for cross-world phenomena. And no explanation of that kind can be given—for several reasons. For example, in giving a physical explanation of disconnectedness we should say how and under what conditions possible worlds are disconnected, and in saying so we will have to name causal factors. This is absurd: there are no causal relations between worlds. Such a defence is defective. To accept it means to return to square one: we in effect declare that no explanation of disconnectedness is possible. This is to ignore the fact that Lewisean worlds, or at least some of them, are physical entities. They are spacetimes governed by physical laws, however alien they are to the actual physical laws. It is hard to see why the relation between them, or the lack thereof, cannot be given a physical account. The modal realist creates a mystery precisely where we are not prepared to grant it.

6

If the argument of Section 5 is correct, then modal realism fails on pragmatic grounds. In a successful reduction, we reduce obscure notions to the notions that are understood better, presumably much better. There is little value in an obscurity replaced by another obscurity. Let me now present a different sort of problem created by Lewis's reduction. We begin with the case of actual disconnected universes. It has been explored extensively in the literature. Let us suppose that there are isolated spacetimes within one possible world. Modal realism cannot accept that. Any two isolated spacetimes cannot be parts of the same world. They are themselves two distinct possible worlds.

However, things actually are in our world, cannot we, on the other hand, entertain a possibility of two isolated spacetimes within one world? The modal realist's answer is that we cannot. Lewis lists four alternatives to such isolated spacetimes.[14] All of them come down to the same idea that actual space, actual time, or actual spacetime are bigger than you might think. The allegedly isolated spacetimes must be embedded in all-encompassing space, or all-encompassing time, or all-encompassing spacetime. The simplest case is that of a higher-dimensional space, where the isolated parts are stacked like flatlands in a three-dimensional space.

Now it might be unclear what kind of possibility is at stake here. If the possibility of actual isolated spacetimes (or spaces and times) is the product of a thought experiment *à la* Quinton and King, then Lewis' rejoinder is well taken. There is hardly any way for the imaginer to eliminate, for instance, a higher-dimensional spacetime enveloping the lower-dimensional parts. There is some textual evidence that Lewis addresses precisely this kind of possibility:

> If you thought, as I did too, that a single world might consist of many more or less isolated world-like parts, how sure can you be that you really had in mind the supposed possibility that I reject? Are you sure that it was an essential part of your thought that the world-like parts were in no way spatiotemporally related? Or might you not have had in mind, rather, one of these substitutes I offer? Lewis (1986:72–73)

Secondly, the possibility concerned may also be interpreted as a physical one, in the sense that such a possibility is asserted by a physical theory. Indeed, it has become a frequent topic in the past 40 years in the discussions in quantum mechanics. Here, Lewis gains support from unexpected quarters. As John Earman observed long ago, it is hard to see how isolated spacetimes can become a subject of a physical theory, so far as no causal interaction is permitted between them. Since there is no empirical evidence about a separate spacetime to feed to the theory, its existence should remain entirely speculative.[15]

Earman, however, does not doubt the logical or physical possibility of isolated spacetimes. For all we know, there may be such isolated spacetimes within *our* universe. But since their existence cannot in principle be subjected to verification, it cannot be a proper part of a physical theory. If we agree on that much, it seems unavoidable that there is a possible world containing more than one spacetime. And if there is such a world, then there is a possible world at which two worlds are actual. It would be easy to trivialise this problem by using the indexical notion of actuality. According to modal realism, actuality comprises me and my surroundings. Since my surroundings are related to me spatiotemporally, the claims about actual spatiotemporally disconnected (spatiotemporal) objects will be incoherent. The reason why Lewis does not

[14] See Lewis (1986:71–73).
[15] See Earman (1970:267).

make such a move is that it would reverse the order of explanation. The modal realist notion of actuality must fall off the correct notion of a possible world, not the other way around. So, rather than invoking his analysis of actuality, Lewis rolls out his four surrogates of isolated spacetimes mentioned earlier. But there is more mystery here than he allows. Since, according to the modal realist, under no circumstances a possible world can contain more than one spacetime, then, in effect, there must be, according to him, some kind of a *rule* preventing the emergence of several actual spacetimes. It is one thing to reject such spacetimes in our universe for the lack of evidence, or to deny the empirical import of their existence. It is a different matter to deny their possibility altogether.

We have now a glimpse of a general problem. Modal realism assumes certain rules governing the behaviour of isolated spacetimes. One such rule is that no more than one spacetime can be actual. Another rule could be put as follows. Let us suppose that there is a multitude of isolated spacetimes. Granted modal realism, they qualify as possible worlds. Let us consider two such universes and further assume for simplicity that they both have the topology of two-dimensional cylinders. Suppose also that these two universes expand. Our naive geometrical understanding tells us that they may eventually collide one with another. Isolated spacetimes may become connected. The physics of their encounter cannot be described by GTR. Some advances were made in quantum cosmology where simplified models were developed for similar scenarios.[16]

We have, therefore, the following argument:

1. The observed spacetime may collide with another isolated spacetime.
2. I and all my surroundings may collide with another isolated spacetime.
3. The actual world may collide with another isolated spacetime.
4. The actual world may collide with another possible world.

The first step of the inference is an assumption putatively based on a physical theory. Each subsequent step follows from the preceding one by a paraphrase. The modal realist is sure to attack claim #1. The observed spacetime may collide with another *actual* spacetime. Though actual spacetimes may collide, merely possible spacetimes cannot. But the protest is ineffective. The only way to distinguish between actual and merely possible spacetimes at this stage is to invoke primitive modality. Mathematical and physical complications notwithstanding, what we can claim is the following: modal realism imposes restrictions on the dynamic evolution of isolated spacetimes. *Given* a coherent possibility of interaction between isolated spacetimes, there must be a factor—a necessary one—preventing it. What this factor could be remains obscure. Moreover, even if we determine such a factor, I think it is clear that it will be of physical nature, having the form of a physical law. If so, it will be found that the structure of logical space is governed by physics.

[16]See Strominger (1991). See also Rucker (1984) for a different approach.

To sum up, the problem of uniqueness and the problem of collision can be viewed as illustrations of a more general *problem of regulation*. In pursuing the reduction of modal notions, the modal realist assimilates possible worlds to isolated spatiotemporal universes. He is then forced to regulate their behaviour with arbitrary rules. The purpose of such regulation is in satisfying our modal intuitions, such as the **S5**-driven intuition that everything that is possible is necessarily so. In the end, rather than obtaining explanatory unity and clarity, we are left with stipulations that add more mystery to modal reality that it deserves.[17]

7

I want to conclude by commenting briefly on two upgrades of modal realism that might be deemed effective in addressing the problem of regulation. One such upgrade, meant to deal specifically with actual isolated universes, was proposed by Phillip Bricker.[18] To recognise actual isolated universes as a genuine possibility we must change the notion of isolation between possible worlds. We say that two universes are isolated just in case there is no natural external relation between them. Spatiotemporal relations fall into just one class of external relations. Other external relations are needed to distinguish between the isolation of actual spatiotemporally disconnected universes and the isolation of possible worlds. The former are still connected by other external relations, while the latter are not connected by any external relations whatsoever.

This could, I think, be a neat solution of the difficulty. The plurality of possible worlds will no longer have to be regulated, since its elements will not stand in any relation whatsoever. So, for example, the scenario of collision will no longer be relevant, since any such scenario would apply to spacetime systems whose elements stand in some external relation to each other. But the solution assumes that actual disconnected spacetimes stand in an external relation to each other. Therefore, it may only work once we have exhibited these external relations. Bricker does not seem to have achieved that. Further, the benefit of using only spatiotemporal relations in Lewis' reduction is that they are supposed to be understood better than modal notions. Therefore, any other relations featuring in the metaphysics of modal realism must be

[17] An alternative way of putting essentially the same idea could be this. According to modal realism, there are Newtonian worlds and there are relativistic worlds. Thus consider two possible worlds W_n and W'_n containing a three-dimensional Newtonian space E^3 and a one-dimensional Newtonian time $\mathbb{R}$, and a possible world W_r containing a relativistic spacetime like $S^3 \times \mathbb{R}$. We must first explain how there can be more than one Newtonian world, since this presumably will mean amending several key elements of Newtonian physics, such as the postulate of absolute simultaneity. After we are done with that, we will have to explain how all three worlds are isolated. But whatever form our theory of isolation will take, there is simply no reason to expect that isolation be physically invariant: the isolation of W_n and W'_n will have to be explained differently from the isolation of W_n and W_r.

[18] See Bricker (2001).

already understood well. For this reason, spatiotemporal relations are good candidates. They feature both in scientific theories and in everyday discourse. Other external relations, however, do not have the same advantage. Although Bricker's version of modal realism might not be worse off than its original version, it does not, I think, get us any further.

The second modification of modal realism addresses the problem of contingent claims about the plurality of worlds. The idea is that claims about the plurality must be accorded special treatment. John Divers has suggested the following 'extraordinary modal principles' to be invoked whenever the statement A is a claim about the plurality of Lewisean universes (or about sets and properties, among other things):[19]

$$\text{It is possible that } A \text{ iff } A. \tag{A}$$

$$\text{It is necessary that } A \text{ iff } A. \tag{AN}$$

$$\text{It is contingent that } A \text{ iff } A \text{ and not-}A. \tag{AC}$$

The explanation by extraordinary modal principles works as follows. Consider a plainly contingent non-extraordinary statement, such as 'Obama is married'. Its contingency is explained in terms of the existence of two distinct Lewisean universes: one in which Obama is married, and one in which Obama is a bachelor. We have then established the truth of an extraordinary statement A, such as 'There are two Lewisean universes'. By the clause (AN) we have that A is necessarily true. It will now follow, in a system as weak as **T**, that A is not contingently true. A similar routine is activated for other extraordinary statements.

Therefore, the truth *simpliciter* of extraordinary statements is established by a modal-realist reasoning. No further question of the modal status of extraordinary statements should arise: the clauses (A) and (AN) ensure that modal operators can be deleted at will from any such statement. That is to say, in the case of extraordinary statements, the notions of truth, possible truth, and necessary truth are made to coincide.

The significance of Divers' amendment for our discussion is that any rules regulating the plurality of possible worlds will be declared necessary, just as the modal realist requires. But the question is: should modal realism be established first, and then the extraordinary principles are brought up to merely illustrate the way it deals with the claims about plurality, or are the extraordinary principles established independently and then used to justify modal realism (namely, the modal status of the claims about plurality)? If the principles are accorded with the former illustrative role, Divers should be understood as making explicit the modal realist treatment of plurality claims. As I will explain in a moment, there is nothing wrong with this goal. Yet we are interested here in the justificatory role of the principles. We want to see whether they can be

[19] See Divers (2002:47–9).

used, for example, to block the problem of regulation and thus vindicate, on independent grounds, one of the central tenets of modal realism.

It is not immediately clear from the text of Divers (2002) what reading the principles should be given. I can think of two ways of interpreting them. On the first interpretation, these principles are meant to be extensionally correct. They are to be read as material bi-conditionals. Then we must regard all extraordinary statements as being either necessarily true or necessarily false. For we observe that the clauses (A)–(AC) hold for any necessary truth and necessary falsehood, such as 'It is raining or it is not raining' or 'It is raining and it is not raining'. There is little we can say against the principles in this case. Of course, as noted already, if *A* is necessarily true, then it is true and possibly true, and if it is necessarily false, then it is false and possibly false. Though the principles will hold, clearly they cannot defend modal realism. They are themselves based on the modal realist assumption that statements about the plurality of worlds—consequently, about the plurality of isolated universes—are all necessarily true or necessarily false. And the unsolved question is the legitimacy of that very assumption. So if we read (A)–(AC) extensionally, they can tell us at most how modal realism is supposed to treat claims about the plurality. Their role will be merely illustrative.

On the second reading, the three principles elucidate the cognitive content of modal claims about plurality. To wit, claims about plurality admit no modal content. Our dropping of modal operators is not only extensionally adequate, but also reflects the correct conceptual analysis of such statements. This interpretation should immediately be qualified, since on the modal realist account there is no genuine *modal* content in any assertion. All there is is the content about Lewisean universes. But even if such a reductionism is granted, it is generally not part of the modal realist view that modal locutions do not contribute to the truth-value of the statement where they occur. They of course do contribute, for this is the reason why the modal realist interprets, for example, 'Obama is divorced' and 'Possibly, Obama is divorced' in two different ways. The extraordinary interpretation, on the other hand, holds the modal ingredient of the extraordinary statements as semantically idle: it contributes at most to their pragmatic force, not their semantic content. That is, we are simply unable to make a substantial modal claim about Lewisean universes (and about sets and properties too, for that matter). This interpretation seems more plausible, since the introduction of the three principles is prompted by an ambiguity of their representation in the counterpart theory.[20]

Now I think that one could convincingly impose special constraints on claims about entities having a special role in our modal thinking. We engage in modal talk about objects of our experience taken in the widest sense, from ordinary middle-sized objects all the way to theoretical constructions of modern physics. We can also reason about properties of the universe as a whole, thus making modal claims about it. But what if we wanted to reason about God? What if we

[20]See Divers (2002:307).

asked whether God necessarily acts in good will or whether He is necessarily active? Our apparatus of possible worlds that worked fine for objects of experience might not be adapted for reasoning about God. There we would reach limits of intelligibility.[21] So the principles can potentially be used in defending a doctrine that refuses to make counterfactual claims about God. In the same way, if we were to reason about sets, the principles might seem plausible too. The content of the claim 'The set of all reals is uncountable' may well be identical to the content of the claim 'Necessarily, the set of all reals is uncountable'. Someone who thinks properly about mathematical objects should not distinguish between how they are and how they could be.

But the trouble is that modal realism assimilates (at least some) possible worlds to physical entities. If we are able to think about spatiotemporally connected galaxies counterfactually, why cannot we do the same with huge isolated collections of such galaxies? Certainly we are allowed to use counterfactuals with collections of galaxies that are spatiotemporally connected. It is puzzling why spatiotemporal isolation should suddenly make such reasoning semantically idle. Therefore, I think, whereas Divers' constraints appear innocuous and rather plausible when imposed on statements about God, sets, and perhaps some other abstract objects, they would seem entirely *ad hoc* with Lewis' worlds. And so, again, the principles cannot be invoked to justify modal realism on independent grounds.

Acknowledgements I am grateful to John Divers, Dorothy Edgington, Gonzalo Rodriguez-Pereyra, and an anonymous referee for helpful comments on earlier versions of this material.

References

Bigelow, J., & Pargetter, R. (1987). Beyond the blank stare. *Theoria, 53*, 97–114.
Bricker, P. (2001). Island universes and the analysis of modality. In G. Preyer & F. Siebelt (Eds.), *Reality and humean supervenience*. Rowman and Littlefield.
Bueno, O., & Shalkowski, S. A. (2000). A plea for a modal realist epistemology. *Acta Analytica, 15*, 175–193.
Divers, J. (2002). *Possible worlds*. Routledge.
Earman, J. (1970). Space-time, or how to solve philosophical problems and dissolve philosophical muddles without really trying. *Journal of Philosophy, 67*, 259–77.
Hale, B., Wright, C. J. G. (2001). *The reason's proper study*. Clarendon Press.
King, P. (1995). Other times. *Australasian Journal of Philosophy, 73*, 532–47.
Lewis, D. K. (1986). *On the plurality of worlds*. Blackwell.
McGinn, C. (1981). Modal reality. In R. Healey (Ed.), *Reduction, time, and reality* (pp. 143–88). Cambridge University Press.
Quinton, A. M. (1962). Spaces and times. *Philosophy, 37*, 130–47.
Rosenberg, A. (1989). Is Lewis' "genuine modal realism" magical too? *Mind, 98*, 411–21.

[21] One should recall here the quandary Leibniz faced with his claim that God necessarily creates the best possible world. I discuss it at some length elsewhere.

Rucker, R. (1984). *The fourth dimension*. Houghton Mifflin.
Russell, B. A. W. (1937). *A critical exposition of the philosophy of Leibniz* (2nd ed.). Allen & Unwin.
Skyrms, B. (1976). Possible worlds, physics, and metaphysics. *Philosophical Studies, 30*, 323–32.
Stalnaker, R. C. (1996). On what possible worlds could not be. In A. Morton & S. Stich (Eds.), *Benacerraf and his critics*. Blackwell.
Strominger, A. (1991). Baby universes. In *Quantum cosmology and baby universes*. World Scientific.