

Minds, Substrate, Measure and Value

Part 7: Convergence on the Mathematical Universe

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This is the seventh in a series of articles about the nature of reality, the nature of consciousness and the relationship between minds and the rest of the world. Previous articles in the series have developed and justified the many-interpretations view, a kind of modal realism in which objects exist due to interpretations of other objects and all interpretations apply. It has been argued that this is needed for a coherent view of probability and emergence. The many-interpretations view implies that we live in an infinite multiverse and that modal realism is true. The existing view has two problems. The first is in its assumption that all interpretations apply. This is assuming too much, and it would make more sense to replace it with the assumption that the structure of interpretations must be formally describable in principle. The second problem is in the distinction between objects and the structure of interpretations that gives rise to them: we can be asked what an object is supposed to be and why it should have any properties at all in itself. A discussion of these problems is given and a revised version of many-interpretations is developed here which resolves both of these problems. The new version of the ontology is very similar to Max Tegmark's mathematical universe or Level IV multiverse hypothesis, yet it has been reached in a different way to that in which Max Tegmark reached his ontology. This means that the argument that has been developed here should be regarded as extra support for the mathematical universe or Level IV multiverse hypothesis. The case made by Richard Swinburne for the existence of God is somewhat damaged by the ontology proposed here. In particular, Richard Swinburne says that a 'wide' multiverse which contains or gives rise to many universes with radically different laws of physics would be more complex than any single universe in it, but this view is flawed: generality is actually simpler than specificity. He also says that considerable empirical evidence would be needed to justify acceptance of a 'wide' multiverse, yet he is wrong on this too: an argument of the kind given here should require us to accept an extensive multiverse. The ontology proposed here is actually about as inimical to theism as an ontology can get.

1 INTRODUCTION

This is the seventh in a series of articles exploring the relationship between minds and physical systems (substrates) on which they are based. Thought experiments have been given showing how probability can seem to become incoherent, because there is no single way in which a mind could be said to be associated with a substrate, and our view of emergence seems to have arbitrariness in it. The many-interpretations view has been developed to deal with this, and the previous six articles have developed and justified this view. (A list of the previous articles in the series [1,2,3,4,5,6], and where to find them on the internet, is at the end of this article.)

The many-interpretations view as described so far does present two problems, and this article will deal with them by developing a revised version of the ontology. This will be done in two stages. The existing many-interpretations view

will be referred to as 'many-interpretations V1.0'. A second version, 'many-interpretations V2.0' will be developed, followed by a third version, 'many-interpretations V3.0'. Many-interpretations V3.0 will replace the previous many-interpretations view.

The first problem with many-interpretations V1.0 is the *explicit* assumption that all interpretations of an object(s) actually correspond to real objects – ones that exist in reality. This idea was introduced to deal with the apparent arbitrariness of a reality in which some interpretations 'work' and not others. In fact, there is reason to think that we went too far in assuming this. Arbitrariness – and the resulting incoherence in probability – can be avoided if we merely demand that the way in which interpretations work is formally defined, without explicitly assuming that all interpretations apply. This idea will be developed in the first revision to the idea: many-interpretations V2.0.

The second problem is that the idea of ‘objects’ is somewhat vague: an object just seems to be information, and it is not clear how an object has properties in itself, apart from those in the interpretative structure that underpins in it. This will be resolved by removing the distinction between objects and the structure of interpretations that gives rise to them, and this will be many-interpretations V3.0.

In previous articles, we have commented on the similarity between what was being discussed and Max Tegmark’s *mathematical universe* or *Level IV multiverse* hypothesis [7,8,9]. Many-interpretations V3.0 will actually be a lot like this view, but it will have been reached by an argument which is different from that used by Max Tegmark, implying that his ontology can be justified in more than one way: this should be regarded as extra support for at least the general idea behind his ontology.

2 THE PROBLEMS ADDRESSED BY THE MANY- INTERPRETATIONS VIEW

The main problems addressed by the many-interpretations view are ones involving *lack of coherence in probability*.

A common understanding of the relationship between the human mind and a physical substrate is that a mind exists when ‘the right processes’ are occurring in the substrate. In the previous articles in this series [1,2,3,4,5,6], various thought experiments have been given to show that this approach is incoherent on account of involving *arbitrariness of interpretation*.

The problem is that, with this view, thought experiments can show that there is no obvious way of saying when a particular mental state is supposed to be implied by a particular physical substrate, or how many minds are implied by a particular physical substrate. Some interpretation of the substrate seems to be needed to find a mental state, or to tell us how many minds are actually implied by some substrate, but there is nothing in the idea that a mind exists when ‘the right processes’ are occurring in the substrate to answer questions about this. Instead, we are forced into a position of arbitrariness of interpretation, where we decide where minds do and do not exist for no reason that can be justified. Questions about the probability of you

being in various kinds of situations cannot be answered by such a view, and probability therefore becomes incoherent.

One objection could be that John Searle’s views are actually correct, and that the whole idea that minds can be substrate independent is flawed [10]. This may seem tempting: it seems to tell us that a mind is only present when we have ‘the right substrate’, but any idea that it resolves the issue is illusory: the same arbitrariness of interpretation is there, a point we have made previously [11]. There is nothing to tell us what the process is that is supposed to cause a mind, or where it begins and ends. Really, this is just like the ‘computationalist’ position – except with most of the possible interpretations that a ‘computationalist’ would accept as finding a mind declared invalid – and the actual way in which interpretations are declared valid or invalid not being made clear to us. Nor is there any hope of finding out how the selection should be made. The same arbitrariness of interpretation is still there, though in a slightly disguised form, and this position, too, is incoherent.

Our concept of emergence is also problematic if we take the view that a thing exists when the relevant pattern exists. Any pattern we want to find in nature can be found *anywhere*, given an appropriate interpretation, so how are we supposed to draw the line between real and unreal things? Again, our existing understanding seems incoherent.

As well as incoherence, it could also be argued that there is a general arbitrariness in reality. Why is reality this way, out of all the ways we might imagine it could be? There will be controversy about whether that is a sensible question, but if it is, one answer is a kind of modal realism which implies that everything exists, and what that we think of as ‘reality’ is merely based on our indexical position.

The many-interpretations view was proposed to account for all this. In the many-interpretations view, objects exist because they can be found, or they are implied, by some algorithmic interpretation of other underlying objects – meaning that a description of the found object can be produced by applying an algorithm to the underlying objects. This applies for human mental states, which are assumed to have actual physical reality: in fact there is no distinction between real things and abstract things in this

view. Further, all objects are assumed to exist on account of being findable by some interpretation of underlying objects – there is no ‘basic’ reality, but rather, instead of turtles, it is interpretations ‘all the way down.’

The idea of modifying the many-interpretations view will now be considered.

3 ADDRESSING THE PROBLEMS IN ANOTHER WAY

The way that has been used to address the problems of incoherence in probability and arbitrariness in many-interpretations V1.0 is not necessarily the only way that could be used. The incoherence in probability comes from not having a formal method for saying which interpretations apply and which do not, if some interpretations happen to apply and not others, and the apparent impossibility, even in principle, of ever getting one. However, what if we simply say that there is a formal method, and that we can obtain an idea about what it is from the world around us?

Reality, according to many-interpretations V1.0 is a structure – a web of contingency and dependency. We can imagine a number of objects existing, and lines extending from these objects, corresponding to interpretations of them, and ending at the objects that are ‘found’. Further lines would extend from these objects and so on. Your mental state would relate to one or more of these objects, and the structure of interpretations leading up to your mental state would show how it is dependent on reality. The whole structure is atemporal and non-spatial. Concepts such as ‘time’ and “space” are only meaningful with regard to relationships between objects in this structure.

The idea that this structure exists is not a unique feature of many-interpretations V1.0. The only thing that might distinguish many-interpretations from other views is in the scope of this structure: we cannot know what the structure is like, so to avoid issues of incoherence with probability, we say that every possible connection in this structure – every ‘interpretation’ exists. The many-interpretations view holds that the structure is as extensive as it is logically possible for it to be.

But do we need to go this far? Given that reality is a structure, could we not say that the structure

of interpretations in reality can be described in some formal way? If there is a pattern to the structure, and we know what the pattern is, we seem to have a coherent view of reality: we become able to say what exists and what does not exist. Even if we do not know what the pattern is with certainty, if we can make probabilistic statements about what the pattern is like in our local situation, we can say useful things about reality. This will be the essence of the first revised version of the many-interpretations view, which will be called ‘many-interpretations V2.0’.

4 MANY-INTERPRETATIONS V2.0

In many-interpretations V2.0, objects still exist because they are ‘found’ by interpretations, but not all interpretations need to exist. Instead, it is asserted that the structure of interpretative connections between objects being interpreted and objects found by the interpretations is formally describable. This can be taken as meaning that an algorithm exists that would describe this structure.

As with the existing many-interpretations V1.0, interpretations can be viewed as algorithms, and the mental states of observers can be regarded as observers in this structure.

With regards to what reality is like in your vicinity, some structure of interpretations would exist locally to you, which would be part of a larger structure, which would be part of a still larger structure, and so on. There would be no end to this: the structure would have no finite depth. Everything – including space and time – that could be found would always be contingent on something else.

Why, though should many-interpretations V2.0 (a formally described structure of interpretations) be preferred to many-interpretations V1.0 (*all* interpretations)? Both ontologies, in principle, are adequate for removing the issue of arbitrariness of interpretation which pushed us into this kind of ontology in the first place. Given that, we should prefer the view that assumes the least – the one which least attempts to force reality to be a particular way. If all interpretations apply then this could be formally described, and this means that, in the view that the structure of interpretations is formally described, one out of all the possible descriptions that the structure could take is the one in which

all interpretations apply. Many-interpretations V1.0 is therefore a special case of many-interpretations V2.0. We should prefer many-interpretations V2.0 because it is the more general case.

An important feature of many-interpretations V2.0, as with many-interpretations V1.0 before it, is that mental states, and their associated basic perceptions – both inner and outer – your feeling of being ‘you’ – exist as objects in their own right – which means that they exist separately of things like brains or computers, having been ‘found’ by appropriate interpretations. In fact, this is really why all this has been done: there was a need to account for the apparent arbitrariness with which mental states could be associated with substrates. This is not Cartesian dualism, however, as a dualist would understand it. The mind is just viewed as a physical object that emerges from underlying, more basic things as anything else does – and the way in which this works is formally describable.

5 REMOVING THE DISTINCTION BETWEEN OBJECTS AND STRUCTURE: MANY-INTERPRETATIONS V3.0

5.1 Reducing Ontology to Structure

Many-interpretations V2.0, and many-interpretations V1.0 which it replaces, assume that objects exist due to the logic possibility of being implied by appropriate interpretations of other objects. There is a distinction here between the objects and the interpretations that find them. An interpretation can be viewed as an algorithm, though it should really just be viewed as any formally expressed mapping of one or more objects onto another object, but what is an object? All that can be produced by an algorithm is data, so an object would have to be viewed as data. This might cause philosophical problems when we consider how basic perceptions are supposed to be reduced to such things: the data itself could only be meaningful due to its associations with other data, but the many-interpretations view seems to suggest that interpretations can produce something which has some meaning in its own right, as a singular item.

The central problem with this idea that an object is supposed to have some existence and

properties in its own right is that the only way that those properties could be meaningfully said to exist is by finding things, corresponding to those properties, in the object by interpretation – yet anything found in this way could itself only be said to have whatever properties it is supposed to have by applying an interpretation to it – so the problem of ‘what gives things their nature’ seems to be getting pushed one stage further up each time.

As an example, suppose we had a library, existing as an object in the hierarchy, and we said that the library contains books. What does it mean to say that this is a library? It can only be represented in the hierarchy as data of some kind. We must mean that books are found in the library by appropriate interpretations – so the existence of the library implies the existence of the books and that is what makes it a library. So, we need to find things in the library that are, in their own right, books. By applying an appropriate interpretation, a book can be found in the library. What does it mean to say that it is a book? We might say that it is a book because it contains the text of James Joyce’s novel, *Ulysses*, and also that it is made of paper, has a book cover, etc. and that there is a relationship between all these things, but the only meaningful way this can be said to be true is if appropriate interpretations can find all this – if the book implies it all. We will just consider the text of the novel. By applying an appropriate interpretation to the book, we can find the text of *Ulysses*, but what does it mean to say that we have found this text? To say that we have text we would have to apply further interpretations, and so on, and so on. At each stage, everything seems to rely, for its nature, on the thing next highest up in the hierarchy, but that thing does the same in turn, so there seems no point at which things actually get properties.

We might think that one way out of this is to say that, at some level in the hierarchy, things get *perceived*, but this falls prey to the same problem. We can hardly point to some nebulous cloud of 0s and 1s and say, ‘There is experience of a mental state! There are perceptions!’ We could only understand some object as corresponding to a mental state if it had the right properties to be a thing that corresponds to a mental state – but we can only say that properties have meaning if we can find them by interpretation – and we are back to square one. Any attempt to find ‘meaning’ in an object

seems to elude us, but we think of meaning in terms of relationships between things. Maybe we can get out of this problem by reducing everything to relationships?

Many-interpretations V2.0 seems to have a lot of similarity with Max Tegmark's mathematical universe or Level IV multiverse or cosmology [7,8,9]. The many-interpretations V2.0 view seems more similar to Max Tegmark's proposal than the many-interpretations V1.0 one, as it seems to suggest an actual structure, with structural properties, rather than 'everything just existing'. The ontology proposed in these articles seems to be converging on Max Tegmark's ontology, and the mathematical universe might give some idea about how to deal with the relationship between objects and the structure in which they are embedded.

In the mathematical universe cosmology there is no difference between objects and structure. Instead, at a fundamental level, there is only structure. The structure can be considered to be a graph connecting points, with the points having no properties at all beyond the connections that they make with other points. Any 'object' is itself just part of the structure – part of the pattern of relationships between points.

This idea will now be used to simplify the many-interpretations V2.0 view. Instead of saying that interpretations and objects are different entities, objects themselves would become merely parts of the structure. One way of thinking about this is in terms of getting inside the objects that are supposed to be having all this meaning and 'explode' them so that they also turn into a structure of relationships – like the structure of interpretations around them. The structure of interpretations, after all, objectively exists. Everything, then, is reduced to a formally describable structure of relationships. This new version of many-interpretations will be called many-interpretations V3.0.

In many-interpretations V3.0, there is nothing except the structure – and the structure is infinite – as it is in the previous versions (V1.0 and V2.0). As before, any part of this structure has a formal description. Any part of the structure depends on the local structure around it, and this in turn depends on the local structure around that, and so on. In this way, any local part of the structure can be viewed as being 'implied' by the structure immediately surrounding it, which is

effectively implementing an 'interpretation' and that in turn as being 'implied' by the structure surrounding it and so on. The 'interpretation' or 'implication' is merely the dependence of specific parts of a pattern on the more general pattern.

With the many-interpretations V3.0 view of reality as consisting of structure only, the previous idea in many-interpretations V2.0 of a reality consisting of interpretations that imply the existence of objects can be considered a kind of high-level view of a special case of this. The *low-level* view would be that part of the structure was embedded in a larger structure with some more general pattern that required it to take a particular form. The higher-level view would be that an object existed which was being implied to exist by an interpretation described by some algorithm.

An important feature of many-interpretations V3.0, as with many-interpretations V2.0 and V1.0 before it, is that mental states, and their associated basic perceptions – both inner and outer – your feeling of being 'you' – exist as objects in their own right – which means that they exist separately of things like brains or computers as separate parts of the structure of relationships. In principle, you could find, for example, the mental state of a human being and, without looking at other parts of the structure, realize that this was a human mind, having human perceptions, but not know what had given rise to those perceptions – which means not knowing what substrate it was associated with in the structure. Without understanding this, the whole idea of why we would have done all this will not make any sense.

6 WHAT CAN WE KNOW ABOUT THE STRUCTURE IN MANY-INTERPRETATIONS V3.0?

6.1 Considering Local Reality

When asking what the structure is like, it makes more sense to consider it locally than globally: you can know something about the structure near you.

To start with, as an observer you have direct knowledge of your basic perceptions – both inner and outer. This can be considered to be knowledge of the structure of reality very 'close'

to you and there must be something existing in the structure of relationships corresponding to your knowledge of your mental state. ‘Close’, here, does not mean ‘spatially close’. In principle, you might not even be an observer who is in space. Rather, it means ‘close’ in a more general sense of the word – not being in a part of the structure that is removed from you through the intermediate connections between ‘found’ objects and the objects being interpreted.

Your direct perception of the structure does not in itself tell you very much. You want to know about reality ‘further out’ from where you are. You choose some ‘distance’ – in terms of number of connections – away from your position. This corresponds to some finite ‘local reality’ around your perceptions. You want to know about this finite reality.

You know that this finite reality will exist within a larger structure, and the nature of this larger structure will impose a formally defined structure on the local reality. This formally defined structure of your local reality can be represented by an algorithm which constructs the structure of the local reality.

6.2 A Mental Image

A helpful mental image may be provided by thinking in these terms:

Imagine that your local reality is a machine, inside an originally hollow space inside a larger machine, and that larger machine has reached into this hollow space and, under the control of some computer program within itself, has constructed your local reality as this machine – and the larger machine is itself inside a still larger machine that constructed it and programmed it, according to its own program.

It should be noted that this is not supposed to give an idea of what is actually happening: reality itself is atemporal and nothing is actually ‘happening’. There is not really a machine, or a computer program. Rather, local reality can be regarded as having been set up in this way because of its position in some larger, formally describable structure which will impose a formally describable structure on it.

6.3 Considering Possible Structures of Local Reality

The structure of local reality can be considered as being described by an algorithm, but you do not know *which* algorithm. This does not prevent you from considering the probabilities that local reality has various features.

If you want to know the probability that the structure of your local reality has some feature, you can use the following approach:

For some integer n , make a list of all algorithms with a length of n binary digits (bits) or less that describe (that is to say ‘construct’) a structure of local reality that is consistent with the basic perceptions of which you have direct knowledge. Count the number of algorithms in the list, N_{Total}

Count the number of algorithms in the list which describe local realities with structures with the feature in which you are interested, N_{Feature} .

You should treat the situation *as if* the algorithm describing local reality is one of the algorithms in the list. The probability that it is one of the algorithms with the feature in which you are interested is therefore given by:

$$\text{Probability (Feature)} = N_{\text{Feature}} / N_{\text{Total}}$$

For a more accurate probability you can repeat the calculation with a higher value of the maximum algorithm length, n , and as n tends to infinity the probability should converge on some value.

This calculation has been performed by assuming that reality is limited to the part of the structure within a certain number of connections of where you are. To make the calculation more accurate, you can repeat it, but this time considering a ‘larger’ local reality – one encompassing the part of the structure out to a larger given number of connections from where you are. With sufficient computing power, you could find out as much as you wanted about the structure of reality – at least in probabilistic terms.

6.4 Limitations of the Approach, and Reasons for Discussing It.

It is not being seriously suggested here that the above method could be a practical way of obtaining information about local reality. In

practice, an approach like this would be unfeasible. A huge number of algorithms would have to be tried to find the tiny proportion of these that happen to describe a structure consistent with your basic perceptions, and the amount of computing power needed to do this will not be available.

Further, the approach presents some philosophical issues. You are supposed to think of local reality as corresponding to one of the algorithms in the list, but clearly it does not: the true list does not have finite size, and it seems incoherent to talk about selecting randomly from this list. This is why, in describing the approach, we referred to treating the situation *as if* the structure of local reality corresponds to one of the algorithms. The real idea here is that the statistics of this list will tell you something about the statistics of local reality: information about the proportion of algorithms in the list with some feature is telling us what the ‘measure across possible worlds’ is like.

Rather than being an actual suggested method, the above approach is described mainly to show how reality is structured, how it can be formally described and how, at least in principle, questions about probability can be answered: as is the case with many-interpretations V1.0, many-interpretations V3.0 seems to address the issue of incoherence. Many-interpretations V3.0 also deals with the issue of apparent arbitrariness in reality: the world is the way that you experience it because that is what your local reality is like, but all of that would merely be a part of a larger structure, which would in turn be part of a larger structure and so on. All worlds would exist somewhere in the structure, and reality as a whole would have no arbitrariness.

6.5 Partial Models

The method that has been described for answering questions about reality is impractical and the explanation of how it works is really a simplification, so what other approaches might be more practical? One approach is to consider *partial models*.

A formal description of some feature that local reality could have might be constructed – such that for local reality to have this feature would be consistent with your direct, basic perception of reality. This formal description would be expressed as an algorithm and would be a partial

model. The amount of information needed to express the partial model would give an indication of the measure across possible worlds in which it applies: the more information needed, the more specific it would be and the less would be the proportion of possible worlds in which it applies.¹

The issue of how to generate useful partial models *efficiently* is beyond the scope of the discussion here, being really a matter for artificial intelligence research, but various ways of doing this might be imagined.

6.6 Prediction

Approaches for finding out, at least in a statistical sense, about the local structure have been discussed, but we will tend to want to do more than this. We will want to predict future events: to know what our expectations of our future events should be like. This will now be given some consideration.

The kind of ontology being discussed here does not consider the structure to be something that ‘changes over time’. There is no fundamental idea of any ‘flow’ of time. Instead, anything that we call time – or space – is just a property of how the structure is organized locally: space and time are emergent properties of the structure, just as cars and trees are, and they would not even exist if the structure were examined sufficiently closely. This kind of ontology precludes an A-theory of time.

This means that when we consider you as an observer, experiencing your basic perceptions of the structure, we are not considering you as an observer who ‘exists over time’. That is not to say that you do not: clearly you do. Rather, it is to say that this idea is not *fundamental*. When we are considering the structure at a deep level, we are beneath such things.

¹ Incidentally, all this has relevance to the existence of God. An approach like this, or one of the other possibilities that has been discussed here, contrasts with that of people who prefer God as the simplest explanation on account of the idea that, to be complex, a thing would need a complex arrangement of parts, and God – having no physical parts – would therefore be simple. This view of ‘complexity’ and ‘simplicity’ is naïve – and it would prevent us assessing the relative complexity of many things, such as two different God concepts or two different scientific theories. Approaches like the ones mentioned here are more general and can deal with more abstract things.

This means that your experience at any time should be viewed as corresponding to basic perceptions which are determined by the local structure for that *instant*. The local structure, surrounding your perceptions is the local structure surrounding an observer moment. We cannot really ask how this observer moment will *change*, because the atemporal view of things makes this incoherent: the basic perceptions that you are having, right now, are just there. Any other observer moments you might have – past or future – are ‘out there’ in the structure.

So, how can you make any predictions based on this? What should you expect to happen? Just as the structure around you provides a context for your basic perceptions – for an observer moment – other parts of the structure will correspond to observer moments for you earlier in time and later in time: these parts of the structure will correspond to your mental experiences. This does present an issue of personal continuity. How do you decide how likely it is that a given observer moment, out there in the structure, corresponds to your future? This, however is an issue in philosophy in general, and has been discussed by others [12]. No attempt will be made to deal with it here.

We will now use these approaches to finding out about reality to show that reality is infinite and that a form of modal realism is true in many-interpretations V3.0.

7 MANY-INTERPRETATIONS V3.0 IMPLIES A KIND OF MODAL REALISM.

Modal realism is the philosophical idea that all conceivable worlds actually exist, and ‘our world’ is not distinguished from the others in any profound way, but merely by an index [13]. We might ask if many-interpretations really implies modal realism, as has been stated earlier in this series. Modal realism is a logical outcome of many-interpretations V3.0, as will now be shown. The argument is in two parts: first it will be shown that the structure of relationships is infinite, and then it will be shown that the infinite structure corresponds to modal realism.

7.1 The structure is infinite.

As described previously, your local reality can be imagined as some formally described

structure inside a larger structure. You can consider the different possibilities for the local structure by listing the different formal descriptions for it, subject to some maximum description length of n bits – or you can formally describe some feature of the local structure and regard the information content in this description as giving an indication of the measure across possible worlds.

Suppose you have been considering your local reality out to some number of connections, C_1 , away from ‘you’, and you have some idea of the statistics that describe the possibilities for it.

You now wonder what is further out – what the larger structure is in which the local structure is embedded. You consider the local structure out to a larger number of connections, C_2 , away from you, where $C_2 > C_1$. For some maximum description length, n , you will have a large number of descriptions, and these descriptions will tend to describe structures extending out as far as C_2 connections away, as there are more ways of specifying a larger structure than a small one. Some of the descriptions will refer to structures that still only extend as far out as C_1 connections away, but they will be a very small amount of the total number of possible descriptions, and as the maximum allowed description length, n , is made larger then the proportion of the total number of descriptions that are of structures only extending out as far as C_1 connections away will become smaller, because it is imposing a restrictive requirement on the kind of description permitted. This can be said for any C_1 : you should always expect the structure to extend beyond any boundary that you imagine.

Further, when you consider the possible structures out to some number of connections, C_1 , away from you, for maximum description lengths of up to n bits, as n tends to infinity, the proportion of the descriptions corresponding to structures that extend out to C_1 will become higher: for a very large value of n , hardly any structures will not extend out as far as C_1 connections away: there are more ways to describe a very large structure than one that has to be arbitrarily small.

All this amounts to a proof that the structure is infinite.

A simple way of thinking about this is in terms of ‘nothing’ being a very specific answer to the question of what is out there: in fact it is the most specific answer possible, as there is only *one* way to have *nothing*, whereas there is an *infinity* of ways of having *something*. To put this another way:

Nothing is more specific than nothing.

The kind of argument used here could be presented in terms of partial models and their amount of information content or specificity across possible worlds: a partial model corresponding to the structure being limited to some size will have an infinitely small measure across possible worlds.

7.2 The infinite structure corresponds to a kind of modal realism.

An infinite structure does not, in itself, imply modal realism. Modal realism holds that every possible world exists, but a structure could be infinite and quite boring. For example, a structure could just be an extension of local reality as we know it, or it could, in principle, consist of an infinity of duplications of local reality as we know it. Why then, should we expect modal realism?

Suppose you consider the local reality, out to some number of connections, C_1 , away from where you are. You should expect, for reasons already discussed, that your local reality will be structured in a certain way – that there will be some kind of pattern of which your basic perceptions are a part. Suppose now that you consider local reality out to C_2 connections away. Should you expect that this pattern will continue – that reality is just more of the same? This would be unjustifiably restrictive. In principle, local reality *could* have the same pattern out to C_2 , but there are more ways for this pattern to be merely a special case of some more general pattern, simply because general things have lots of special cases and there are lots of ways for something to exist as a special case of something else. To demand that some larger pattern is exactly the kind of pattern as that seen in our local reality is to put a very restrictive requirement on it, while to demand merely that some larger pattern has some *part* of it that is the same kind of pattern seen in our local reality is less restrictive, because the pattern can have lots of such parts – and each such part effectively

amounts to a ‘different attempt’: the more general structure, of which our local structure is a special case, is effectively getting more chances to ‘enter the lottery’.

Now, someone could create a straw man from this and say that it tells us not to expect any structure in reality, even locally. If local reality out to C_1 is merely a special case of larger reality, why expect anything beyond what you have directly experienced to match your expectations in any way? Why not say, instead, that everything that you know is simply a special case of a larger pattern and that we can have no idea what exists beyond your immediate perception?

Such a view, however, is treating the larger structure out to C_2 as if it is some arbitrary, random structure, and local reality out to C_1 just happens to be a small part of it – with no relationship to any other part of it. The larger pattern, however, is being viewed as having a *formal description*, and a formal description corresponding to a pattern which just happened to have the local reality out to C_1 as a special case and everything else not resembling it at all would be very complicated and specific: the proportion of formal descriptions corresponding to such formal descriptions would be small. The proportion would be much greater for formal descriptions corresponding to structures, out to C_2 , in which the larger pattern was a more general case of C_1 , but was still something like it. In fact, we have shown earlier that knowing something about a part of the reality should tell you something about larger patterns in it, so if this were not the case, it would conflict with such ideas.

Now, suppose you know what the structure is out to C_2 (and you cannot know with certainty, of course, but we are just supposing). What you know about is a general case of which the local structure out to C_1 is a part. Suppose that you now look further out – as far out as C_3 which is twice as far as C_2 . Again, what you should find out there should be a general case of which local reality out to C_2 is a special case – but there should still be some kind of general pattern. Local reality out to C_2 is itself, however, a general case of local reality out to C_1 , so things have now become more general still. As you look further out into reality, the reality local to you should become an increasingly special case of some more general case, but even if you look

very far out and find some very general case, that general case will itself become a special case on looking further out. The conclusion – modal realism – should be inescapable.

Another way of viewing this is that, as has been discussed previously, you can expect what you know about the structure locally to tell you about the structure further out, but as you go further out, what you actually know about the structure represents a progressively smaller piece of it, so what it tells you about reality becomes increasingly less useful. If you look out to some small extent, you should still have strong expectations of what reality will be like, because you have seen a lot of it, but if you look very far out indeed you should have hardly any idea at all about what reality is like, because you have seen hardly any of it – and there are many ways in which your piece of reality could exist in some larger reality. As far as you are concerned, reality, so far out, is effectively ‘anything goes’ – and you should expect any conceivable special case to be a part of reality somewhere.

All this means that, if you know about a small part of the local structure, as you look further out, the part of the structure that you know about should become part of an increasingly general pattern. If you go far enough out (and this does not mean in a spatial sense, but in a kind of ontological sense, here), you should see ‘places’ like your own, with the same laws of physics and physical constants, but with different arrangements of matter. By going further out still, you should see a reality consisting of worlds like your own, with the same laws of physics and physical constants. Further out still, you should see worlds with different laws of physics. Further out still, even concepts such as space and time will be revealed as the provincial customs they are, and will be seen not to apply in most of reality. That does not mean that there is ‘nowhere else’ with space and time: other worlds with space and time will exist – somewhere. In fact, pretty much anything you can imagine will exist ‘out there’ – but there is no reason to think that concepts like space and time are an important part of reality – that they are anything more than provincial concepts in the rare ‘islands’ where they exist.

A consideration in statistical ontology, then, seems to oblige us to accept modal realism.

7.3 The argument for an infinite reality and modal realism does not rely specifically on the many-interpretations ontology.

The argument for an infinite reality and modal realism has just been made within the context of the many-interpretations ontology, but it is not really dependent on that ontology. Even if you do not accept the specific ontology being proposed here, the same kind of argument should still show that reality can always be extended, and that as you look further out it should appear more general, with your own ‘corner’ of it becoming an increasingly special case.

7.4 Modal realism should make intuitive sense.

The argument for modal realism given here should agree with intuition. You might conceivably have no reason for thinking that space and time extend beyond your immediate experience, but you do, because you *generalize*. You take what you know and assume that it is part of something more general – that the space you experience around you with arrangements of objects is a special case of some larger space that extends with more varied arrangements of objects, that the time you have experienced with specific events is a special case of some time that extends further into the past – before you started experiencing time – and further into the future – beyond the present, with more events. You assume that patterns of arrangements of matter in space and events in time are special instances of more general patterns, and that natural laws tell you about these patterns. Even if you are not consciously aware of it, you already generalize as you look out into the world: you need to in order to function in it.

In fact, this gives us a partial answer, possibly, to Hume’s problem of induction. One reason that we may feel entitled to generalize about the external world is that that is all that the external world *is*. If we are not to say that the external world is a generalization of our perceptions, what purpose does it serve even to postulate that the thing exists, that there is *anything* out there? Viewed this way, Hume’s problem of induction seems to become merely another way of asking why we should not subscribe to solipsism.

And solipsism is essentially what you are doing if you deny that we should generalize like this. Someone who denied that his perceptions were a

special case of something more general, and instead refused to extend reality beyond his basic perceptions into something more general, would be a solipsist, but to accept this idea of extending reality beyond yourself and then *selectively* apply it – to insist that you can generalize about arrangements of matter or events in time, but to a greater extent – could be viewed as a ‘little solipsism’.

7.5 How can there be many ways of having everything?

There may *seem* to be a paradox in the argument. We have said:

Nothing is more specific than nothing.

And we have ended up with modal realism, but could it not be said that modal realism is equally specific? If you have a description of everything, could it not be said that it can only take one form – a description of everything? We are used to thinking in terms of ‘everything’ implying a lack of possibilities. For example, people often ask what you buy the person who has everything – the idea being that there are no possibilities. But have we not just seen an argument that suggests that expanding our view of reality makes it more general *and* creates more possibilities? Is this not a contradiction?

There is no contradiction here. The way that we have reached modal realism is by expanding our view *from our perspective*, so that it encompasses progressively more, and we have shown that there will always be more there, and that it will become increasingly general. We are talking here about an *observer-centred world*, where the description of reality is everything that exists ‘around’ your perceptions. As the worldview starts to become more general, there can be increasing uncertainty about what the description of the world is around you, which means there are more ways ‘for things to be’.

One way of imaging this is in terms of increasing uncertainty about ‘where you are’ in the multiverse. As your idea about reality becomes more general, there is more scope for situations like yours to exist, in different parts of reality, and there is increasing uncertainty about which of these situations is yours.

While thinking in terms of ‘where you are in a multiverse’ may be useful in gaining an

understanding of why this contradiction does not exist, we have to say that we prefer to avoid such a view: it is better if we can just realize that observer-centred worlds can approach modal realism and become increasingly general as the number of possibilities increases. It is our opinion that, because we are obliged to do our statistics in terms of observer-centred possible worlds, that that is probably the only thing that we can really coherently discuss. All of our discussion should be in terms of what exists from our vantage point. This is not a claim of solipsism: no claim is being made that the world is not ‘out there’. Rather, it is being suggested that the only coherent way of expressing a description of the world is as a description of an observer-centred world.

This does not, incidentally, imply that things only exist when being observed: an observer-centred world description can talk about things that might be out there, that have different probabilities of being out there, that have been out there or that will be out there. This is merely about how a description of the world can be expressed.

In a sense, this means that we never actually confront modal realism directly. The modal realism of many-interpretations is somewhat of a philosophical abstraction – like the ‘infinitely small’ dx or dy in differential calculus (at least as many people imagine it). As we expand our worldview, we should expect it to become more general and to become more like modal realism, but we can never actually expand our world view to infinity while constructing any real model of the world. Modal realism, therefore, is what things will *tend* to being look as you look at more of reality beyond yourself.

8 MANY-INTERPRETATIONS V3.0 AND THE MATHEMATICAL UNIVERSE

Many-interpretations V3.0 views reality in terms of nothing more than an infinite, formally described structure of relationships in which every other possible structure exists. This makes it look a lot like Max Tegmark’s mathematical universe or Level IV multiverse [7,8,9], but this idea has been reached in a way that is mostly different to that used by Max Tegmark. The argument given here therefore provides extra support for the mathematical universe, in

addition to that already provided by Max Tegmark, and the combined arguments should strongly suggest that at least the general idea behind the mathematical universe or Level IV multiverse hypothesis is correct.²

9 MATTERS IN WHICH RICHARD SWINBURNE IS WRONG

The ontology that we have developed, and the arguments made to support it, cause problems for some of the justifications that tend to be used for God's existence, and as an example we will consider Richard Swinburne's arguments that God exists.

9.1 Richard Swinburne uses a naïve idea of 'simplicity'.

Richard Swinburne says that God is the preferred explanation of the universe on account of being simple, and that God is simple on account of being a singular entity, because one thing is simpler than a number of things, stating:

'There could in this respect be no simpler explanation that one which postulated only one cause.' [15]

The argument made in this article should have made it clear that, all else being equal, the plausibility of a hypothesis should be considered in terms of 'the number of ways it could be true' and in similar ways, and that generality is more plausible than specificity. Ideas of 'complexity' and 'simplicity' should clearly relate to such things and should be viewed in information-theoretic terms. Richard Swinburne's approach to the matter here should seem, ironically, over-simplistic.

9.2 Richard Swinburne seems to assume that time is fundamental, yet it is not.

Richard Swinburne's view of God seems to be one in which God is assumed to exist in time, with us, experiencing the same 'flow of time' that we seem to experience. For example, he says:

'It is simpler to suppose that God exists eternally. If he came into existence only at a

certain past moment of time, there would have been some earlier period of time at which what happened would have had nothing to do with God. Other forces would have been at work...' [16]

It is not necessarily absurd to say that what we perceive as 'local reality' is created by some being who exists in time with us, but has, in some sense, a 'better perspective' on reality. Ways in which this could occur can be imagined. For example, Nick Bostrom's simulation hypothesis [22] suggests that idea that 'our world' could really be a computer simulation created by humans or non-humans. This is not to say that such things are likely – this is not an issue for us here – but rather that they can be conceived. The is useless to the theistic case, however, because such a being is inadequate for filling the role of God. With time being a local feature of the structure, rather than fundamental, in the many-interpretations view, any being experiencing this flow of time with us must himself be a local, emergent feature of the structure. Such a being would only have power locally and would be an insignificant feature of reality. It should be hard to see why we would give him the name 'God', according to the sense in which the word is traditionally used.

Is Richard Swinburne really asserting this, however? We might imagine some structure with its own time, in which some being exists who has 'created' our local reality with its space and time, so that such a being is outside time and yet still experiences his own time. How do we know that Richard Swinburne is not suggesting that God experiences such an 'analogue' of time in this way? In fact, evidence that Richard Swinburne is not thinking in these terms is provided by his belief that God cannot predict future human actions when humans behave according to 'free will'. He says:

'...no one (not even God) can know today (without the possibility of mistake) what I will choose to do tomorrow. So I suggest we understand God being omniscient as God knowing at any time all that is logically possible to know at that time. That will not include, before they have done it, of what humans will do freely.' [17]

Richard Swinburne seems to reject the logical possibility of any being having a vantage point 'outside' our time. (He does state, incidentally,

² A further argument for a variant of the mathematical universe or Level IV multiverse hypothesis has been provided by Saibal Mitra [14].

that this is *'not the normal Christian (or Jewish) or Islamic view'* [17].)

Richard Swinburne also makes it clear that he believes in a God who exists in time rather than some kind of timeless God:

'I prefer the understanding of God being eternal as his being everlasting rather than as his being timeless. He exists at each moment of unending time.' [18]

Such an idea of God seems to be an idea of a provincial God 'grounded' in concepts such as 'time' which are provincial concepts in the many-interpretations view.

What if Richard Swinburne did not think in terms of God existing in our time? Even if God were supposed to be in some 'higher' time – something like our 'time' at some more general level of reality – it would hardly solve the problem. The many-interpretations view would simply say that an observer in such a time could look out from his vantage point and 'run' the kinds of arguments here to work out that whatever passed as time for him was, like everything else he knew, an emergent, special case of some more general pattern that is 'out there'. The many-interpretations view simply has no place for a 'fundamental' time: it has no place for a fundamental *anything* beyond the basic ideas we use to build the ontology. Any idea of God as a temporal being – whether 'our' time or a 'higher' one seems doomed to failure, yet our idea of mental experience is of a series of mental states occurring over time, and it should be hard to imagine an atemporal mind, so there does not seem to be much alternative. In thinking in this way – in 'grounding' God in our time – Richard Swinburne's view does not really fail when it might otherwise have succeeded: rather it just fails *early*.

The many-interpretations ontology also leaves William Lane Craig's 'Kalām cosmological argument' – an attempt to prove the existence of God [23] – somewhat battered: William Lane Craig clearly needs to assume an A-theory of time – which many-interpretations rejects – in part of the argument against actual infinities that he uses to support his main argument. The entire many-interpretations ontology itself is, of course, a direct challenge to William Lane Craig's insistence that actual infinities cannot exist in

nature: the argument that we have given suggests that they are *necessary*.

9.3 Richard Swinburne is wrong about the complexity and plausibility of a multiverse.

Richard Swinburne's work displays some serious misconceptions about the idea of a multiverse.

He says that a multiverse should have general laws simple enough for us to understand if we postulate one in the first place:

'The fact that the multiverse is governed by very general laws, simple enough for us to comprehend (as they must be if we are to be justified in postulating a multiverse), means that all the material objects throughout the universe have the same very general powers and liabilities as each other.' [19]

But, of course, this is not the case: the argument used to justify the multiverse has not relied on any specific physics, but instead on deeper, philosophical ideas.

Richard Swinburne claims that for a multiverse to contain or give rise to many specific universes³ of many different kinds, with radically different laws of physics – what he calls a 'wide' multiverse – would make it more complicated than any of the individual universes which it contains or to which it gives rise: the implication is supposed to be that a multiverse, as an explanation for any specificity in nature that seems to allow us to exist, is a complicated idea:

'...the very general laws of a very wide multiverse of this kind would have to be enormously complicated. Any very general laws, by which some parent universe would produce daughter universes governed by quite different kinds of specific laws from those which operated in the parent universe, would need to be far more complicated than ones which merely produced universes governed by laws differing from the laws of the parent universe only by containing different constants.' [20]

This is not the case. In fact, as has been pointed out by Max Tegmark in his own argument for the mathematical universe, *specificity is complicated and generality is simple*. As we look further out into a multiverse, from the special

³ using the word 'universe' in a diminutive sense

case of our vantage point, we should see more generality, and this generality is simple in the sense that there are increasingly more forms that reality could take and still provide this generality. In any event, we should really be thinking in terms of a general pattern rather than ‘general laws’.

Richard Swinburne says that a lot of empirical evidence (more than we can feasibly obtain) would be needed for a ‘wide’ multiverse:

‘...we would need a lot of new observational evidence (more than we are ever likely to obtain merely by observing our universe, which is all we can do)...before we would be justified in postulating a wide multiverse.’ [20]

He is wrong on this. Modal realism is not merely viable: it is actually what a proper consideration in statistical ontology should *require* us to accept, based on the philosophical argument given here.

The argument for modal realism given here has refuted Richard Swinburne’s argument – and this argument would still make sense without the specific ontology that we have been using here.

9.4 Many-interpretations is inimical to God, anyway.

We have examined some of the issues with Richard Swinburne’s specific arguments for the existence of God, but the many-interpretations ontology would make it difficult to make any argument for God that made sense anyway. Richard Swinburne proposes God as a ‘simple’ explanation, and he argues that God is a reasonable ultimate explanation [21], but the ontology proposed here gives us a properly-developed idea of what an ‘explanation’ is. Explanation should be thought of as *generalization*.

When we perceive reality we perceive a special case. We assume that that special case is part of a larger reality, in which it is a less special case, and if we can work out what some of the features of that larger reality are likely to be then we have a kind of explanation – and we can do this by considering how common various features are likely to be across all the different larger realities that we can imagine. This larger reality is a more general case than the part of reality we perceived directly. We assume that that larger reality is

itself part of a still larger reality – part of some still more general case, and again we can do some statistics to work out, by considering the measures across possible realities of different possibilities, what the most likely features are for such a larger reality to have. We can continue – progressively expanding the scope of our worldview – and we will encounter an increasingly general situation.

We can always explain more by expanding our view and encountering more generality. The ultimate extension of this – the ultimate explanation – is the ultimate in generality – modal realism – and beyond this there can *be* no explanation: nothing can be more general. There is no need for God in an ontology like this, and no place for God: many-interpretations is about as inimical to God as an ontology can get.

10 CONCLUSION

It has previously been argued that there is incoherence in probability when we take a view of the kind that a mind exists when ‘the right kind of process’ is occurring in a substrate. There did not seem to be any clear way of saying when a mind exists and when one does not, and various thought experiments have previously shown that it becomes practically impossible to answer various questions about probability. It was also pointed out that there is incoherence in our view of emergence, as any object could be found in any other, given an appropriate interpretation.

The many-interpretations view was proposed to deal with this incoherence and arbitrariness, but this involved an unnecessarily complicated ontology, assumed too much, and presented problems. A revised version of many-interpretations, many-interpretations V3.0, has been proposed to deal with these issues.

Most of the justification for many-interpretations V3.0 is the argument that has been developed throughout the earlier articles in this series, with later parts of the argument having been added in this article. If we just think that consciousness is associated with ‘the right processes’, various thought experiments can be used to show that probability is incoherent and weak-substrate dependence needs to be accepted. When we consider the issue of whether an observer is ‘in’ a substrate or not we run into incoherence if we cannot say, at least in principle, what kinds of

interpretation of the substrate we will accept. Further, our idea of emergence is incoherent if we cannot say, at least in principle, what is needed for a 'pattern' to correspond to a real thing. The incoherence is due to arbitrariness of interpretation. Much of the discussion so far has been aimed at showing how this incoherence is there and how it will not easily go away. The approach suggested previously, now known as many-interpretations V1.0, has been to resolve the issue of arbitrariness of interpretation by regarding all interpretations of objects that 'find' an object as actually finding a real object, and therefore to regard all interpretations of objects that 'find' observer's mental states as actually finding real observer mental states.

A revised version has been described – many-interpretations V2.0. Many-interpretations V2.0 does not require that all interpretations correspond to real objects: rather, it is merely required that the structure of reality – the structure of interpretations and objects – is formally described. Any local part of reality should be viewed as a formally described part of a larger pattern, and that pattern will impose the formal description on local reality. The statistics of the possible ways in which this formal description could be imposed will determine what features of the local reality are the most likely ones.

So, why should many-interpretations V2.0 (a formally describable structure of interpretations) be preferred to many-interpretations V1.0 (all interpretations)? A good argument can be made that it should be. To have a coherent view, all we need is something that can be formally described, at least in principle, and many-interpretations V2.0 gives us that. A reality in which all interpretations apply – many-interpretations V1.0 – is actually a special case of this. Assuming that the structure of interpretations in reality can be formally described is merely assuming that reality must take one of an infinity of formally describable forms – just one of which is a reality in which all interpretations apply, so by assuming that all interpretations apply we are limiting our ontology without cause. Instead, we should just assume that the structure can be formally described – which establishes many-interpretations V2.0 as the preferred ontology.

With many-interpretations V2.0 established as the preferred ontology, we have a reality which

is represented as a formally describable structure of interpretations. Interpretations are applied to objects and 'find' or 'imply' other objects. One issue here is that the ontology uses two kinds of entities – interpretations and objects – and it would be desirable to use only one if possible. Further, there are problems with saying that human mental states or perceptions correspond to these objects. An object would have to be information – some collection of 0s and 1s – and to say it had some property could only mean that it had some internal relationship between things – and those things and the relationships between them could be found by appropriate interpretations, but what makes the things thus found the things they are supposed to be that they can give their properties to the original object? To be these things they would need to have properties, which can only be said to exist by appropriate interpretation, and so the problem gets pushed up another level.

Any really meaningful statement about what an object is like internally could only refer to its internal structure. However, this would mean that the properties of an object are expressed in terms of relationships. Relationships can be expressed outside objects, as part of the structure of implication in reality, so this suggests that anything meaningful that could be said about an object could be expressed in terms of relationships between simpler objects. The ultimate extension of this is that there is nothing except structure: reality is reduced to the structure of relationships in many-interpretations V3.0.

In many-interpretations V3.0, reality is an infinite structure. This can be justified in terms of a local part of reality and the description of the larger reality in which it is embedded. We can make a reference class of possible descriptions of the structure of this larger reality, but the possibility of *nothing* in this larger reality – of no structure at all – is merely a special case of such a possible description. There is only one way that such a situation can occur – there is only one way to have nothing – and this specificity means it cannot take up any real part of the reference class of possible situations. To put this another way:

Nothing is more specific than nothing.

Many-interpretations V3.0 implies that a kind of modal realism is true – that all possible worlds

actually exist as part of the structure of relationships. This is because there are more ways for a small part of reality which you know about to be a special case of a more general pattern in a larger piece of reality than for it to be part of a structure which merely has a larger version of the pattern evident in the smaller piece. This argument applies whenever we increase the size of the piece of reality being considered, with the description of reality becoming increasingly general. As you look further out from your vantage point in reality you should expect to see a reality that becomes increasingly general, and the implication of this is that everything conceivable exists.

Many-interpretations V3.0 looks a lot like Max Tegmark's mathematical universe or Level IV multiverse, but it has been reached using a different argument to that by which Max Tegmark reached his ontology. The argument given here therefore provides extra support for the general idea of the mathematical universe or Level IV multiverse, in addition to that already provided by Max Tegmark, and the combined arguments should strongly suggest that at least the general idea behind the mathematical universe or Level IV multiverse hypothesis is correct.

Previous reference was made to a 'cosmological' version of the many-interpretations view, which dealt with reality in general, rather than just minds, but the ontology has become so obviously about reality in general that this does not really need stating any more. 'Many-interpretations' is now assumed to refer to an ontology for reality in general. As many-interpretations V3.0 seems to be an improvement on many-interpretations V1.0, it will replace the previous version. Many-interpretations V3.0 will now simply be referred to as 'many-interpretations'.

The case made by Richard Swinburne for the existence of God is somewhat damaged by the many-interpretations view. In particular, he claims that a multiverse which contains or gives rise to many universes with radically different laws of physics would be more complex than any single universe in it, but this view is incorrect: generality is actually simpler than specificity. He also says that considerable observational evidence should be needed to persuade us to accept a 'wide' multiverse, yet he is wrong on this too: an argument of the kind given here should require us to accept a kind of modal realism on philosophical grounds alone.

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