University of Missouri, St. Louis
IRL @ UMSL

Theses | Graduate Works

4-20-2007

Organizing Space-time: A Causal Analysis of Spatiotemporal Location

John J. Gabriel
University of Missouri-St. Louis, john.gabriel@umsl.edu

Follow this and additional works at: http://irl.umsl.edu/thesis

Recommended Citation
Gabriel, John J., "Organizing Space-time: A Causal Analysis of Spatiotemporal Location" (2007). *Theses*. 238.
http://irl.umsl.edu/thesis/238

This Thesis is brought to you for free and open access by the Graduate Works at IRL @ UMSL. It has been accepted for inclusion in Theses by an authorized administrator of IRL @ UMSL. For more information, please contact marvinh@umsl.edu.

ORGANIZING SPACE-TIME:

A CAUSAL ANALYSIS OF SPATIOTEMPORAL LOCATION

by

John J. Gabriel
Bachelor of Arts, Philosophy, University of Wisconsin, Madison, 2002

A THESIS

Submitted to the Graduate School of the

UNIVERSITY OF MISSOURI – ST. LOUIS

In Partial Fulfillment of the Requirements for the Degree

MASTER OF ARTS

in

PHILOSOPHY

April, 2007

Advisory Committee

Berit Brogaard, Ph.D.,
Committee Chair

Robert Northcott, Ph.D.

Jon McGinnis, Ph.D.

© Copyright 2007
by
John J. Gabriel
All Rights Reserved

ACKNOWLEDGMENTS

Thank you to Berit Brogaard, Robert Northcott, and Jon McGinnis for comments and useful discussion. Thank you to an audience at the Iowa Philosophical Society Annual Meeting for comments on an earlier draft. Thank you to the participants in the metaphysics seminar at the University of Missouri, Saint Louis, for useful discussion.

ABSTRACT

Presentism is the view that our most unrestricted quantifiers range over only those objects temporally located at the present moment. Nothing exists outside the present moment. Eternalism is the view that our most unrestricted quantifiers range over objects in the past, present, and future. No matter how remote an object's temporal location, it still exists at the present moment.

I argue the eternalist's view forces him to make a distinction the presentist needs not. The eternalist must admit that for an object to be temporally located at a time it must have a feature above and beyond mere existence at that time. But discovering what feature differentiates the temporally local objects from the merely existing objects proves a difficult challenge.

I claim, when we distinguish between the temporally local objects and the temporal distant objects, we appeal to whatever organizing principle holds between the space-time points that constitute the universe. The question becomes what is the organizing principle between those points.

I posit causation as that organizing principle. I detail how causation must be characterized so that it may serve as that principle. I defend my characterization of causation from the charge that it rules out manifestly possible circumstances. And I respond to the objection that my view is unmotivated by the tenets of Humean reductionism and genuine modal realism.

INTRODUCTION

Philosophers don't agree on much. But they agree that Socrates is a philosopher. Ted Sider is too. They agree that Socrates is Greek, while Sider is New Jerseyan. They agree that Sider exists now. Does Socrates? Metaphysicians provide two competing answers.

The first is presentism. Presentism is the view that it is always the case that there are no non-present objects.[1] Ned Markosian describes presentism this way:

> According to presentism, if we were to make an accurate list of the things that exist, i.e., a list of all the things that our most unrestricted quantifiers range over, there would not be a single non-present object on the list. Thus, you and I and the Taj Mahal would be on the list, but neither Socrates nor any future grandchildren of mine would be included.[2]

The second is non-presentism. Non-presentism is the view that it is sometimes the case that there are some non-present objects.[3] Markosian describes non-presentism this way:

> According to non-presentism, on the other hand, non-present objects like Socrates and my future grandchildren exist right now, even though they are not currently present. We may not be able to see them at the moment, on this view, and they may not be in the same space-time vicinity that we find ourselves in right now, but they should nevertheless be on the list of all existing things.[4]

---

[1] Ned Markosian, "The 3D/4D Controversy and Non-present Objects," *Philosophical Papers 23* (1994): 3.

[2] Ned Markosian, "A Defense of Presentism," in *Oxford Studies in Metaphysics*, ed. Dean W. Zimmerman, vol. 1 (Oxford: Oxford University Press, 2004), 1-2.

[3] Markosian, "The 3D/4D Controversy," 3.

[4] Markosian, "A Defense of Presentism," 2.

The most influential form of non-presentism is eternalism. Sider explains eternalism as follows:

> Time is like space regarding the reality of distant objects. Spatially distant objects, such as objects on Mars, are just as real as objects here on Earth...Likewise…temporally distant objects, such as dinosaurs, are just as real as objects we experience now...The view that temporally distant objects are real is sometimes called "eternalism."[5]

It seems to me that eternalism is the more reasonable view. But Markosian claims presentism is the view the average person on the street would accept.[6] Presentism does have some commonsense appeal. Presentism appeals to common sense because it claims that our subjective experience of the passage of time tracks an objective feature of reality.

According to presentism, from moment to moment, objects both come into and go out of existence.[7] Only the space-time points that make up the present moment truly exist. Those regions of space-time that are wholly past don't exist anymore. And those regions of space-time that are wholly future will not exist until they've become present. On presentism, time truly passes.

Eternalism doesn't give much metaphysical credence to our subjective experience of time.[8] In describing eternalism, Sider notes:

---

[5] Theodore Sider, "Temporal Parts," in *Contemporary Debates in Metaphysics*, ed. John Hawthorne et al. (Oxford: Blackwell, Forthcoming), 3.

[6] Markosian, "A Defense of Presentism," 2.

[7] To be perfectly accurate, only instantaneous objects come into and go out of existence. Enduring objects remain in existence from moment to moment.

[8] I use "eternalism" here as synonymous with the B-theory of time.

> Time is like space regarding the relativity of here and now…What is called "here" changes depending upon who is using the word…According to some, the word "now" works analogously…There is no one true now.[9]

According to eternalism, our experience of time tracks nothing in reality. There is no one true present moment, and time does not pass. Without the steady advance of the objective present, how could it?

When it comes to engaging our common sense, presentism has the advantage. But committing to presentism comes with some liabilities. We talk about, and seem to quantify over, non-present objects all the time. For instance, how can we now say, "Socrates was a philosopher," without referring to the non-present Socrates?

The eternalist has no problem now referring to the non-present Socrates because, according to the eternalist, Socrates exists, and hence vacuously exists now. But while the eternalist may quantify over non-present objects, the presentist must employ primitive sentence operators.[10]

On eternalism, "Socrates was a philosopher," is true iff Socrates exists and is a philosopher at some time *t* earlier than now. On presentism, "Socrates was a philosopher," is true simply in virtue of the primitive past-tense operator.

On presentism, "Socrates is a philosopher," is false, since at the present moment Socrates neither exists nor is a philosopher.[11] But, "Socrates was a philosopher," is true, not because of any properties Socrates possesses (he doesn't exist to possess any), but

---

[9] Sider, "Temporal Parts," 3.

[10] Theodore Sider, "Presentism and Ontological Commitment," *The Journal of Philosophy 96* (1999): 1-2.

[11] When I here say, "Socrates is a philosopher," I am using the present-tensed "is," not the tenseless "is."

simply because of the operator. In order to vindicate our intuitions about past-and-future-tensed sentences, the presentist must rely on his primitive temporal operators.

When it comes to specifying the truth conditions of sentences, eternalism has the advantage. The eternalist is not committed to the primitive temporal operators that the presentist must endorse. But does eternalism really carry the day when it comes to economy of primitives? To clarify the issue, let's look at a poor argument against eternalism.

THE PUZZLE OF TEMPORAL LOCATION

Recall that, according to eternalism, both Socrates and Sider exist now. Socrates is Greek, while Sider is New Jerseyan. If I get in my car and drive to Jersey, I bet, if I look hard enough, I'll be able to find Sider. If I get on a plane and fly to Greece, I bet I won't have the same luck finding Socrates.

Of course, this isn't a convincing argument. When eternalists say that Socrates exists now, they are not implying that we can fly to Greece and find Socrates. We all agree that Socrates is not in the same space-time vicinity that we are in right now. But even from this poor argument, we can glean a kernel of truth. There is a distinction the eternalist must make. Markosian defines it as follows:

> Let us distinguish between two senses of 'x exists now'. In one sense, which we can call the temporal-location sense, this expression is synonymous with 'x is present'. The non-presentist will admit that, in the temporal-location sense of 'x exists now', it is true that no non-present objects exist right now. But in the other sense of 'x exists now', which we can call the ontological sense, to say that x exists now is just to say that x is now in the domain of our most unrestricted

> quantifiers, whether it happens to be present, like you and me, or non-present, like Socrates.[12]

Given this distinction, the eternalist can truly say that both Socrates and Sider exist now in the ontological sense. But only Sider exists now in the temporal-location sense. Socrates is not temporally local to now.

The distinction between the ontological and temporal-location senses of existence is not one the presentist has to make. Even if the presentist were to make such a distinction, it would collapse upon itself. Recall that presentism is the view that only present objects are in the domain of our most unrestricted quantifiers. For the presentist, saying that *x* is in the domain of our most unrestricted quantifiers is saying that *x* is present. For the presentist, to say that '*x* exists now' in the ontological sense is to say that '*x* exists now' in the temporal-location sense and vice versa.[13]

But for the eternalist, making the distinction between the ontological and temporal-location senses of existence is essential. The eternalist holds that Socrates exists now. That means that, at this present moment, Socrates is within the domain of our

---

[12] Markosian, "A Defense of Presentism," 2.

[13] I have argued that the presentist does not need to make a distinction between the ontological and temporal-location senses of existence because, for the presentist, the set of things that exist in the ontological sense at any given moment and the set of things that exist in the temporal-location sense at that moment are always coextensive. To me, it seems that, once one realizes that Hesperus and Phosphorus denote the same object, to posit a distinction between them is to multiply meanings beyond necessity. But the eternalist might object that, if the presentist does not posit a distinction between the two senses of existence, then by the presentist's lights, his own view is trivially true, and the eternalist's is trivially false. If, by the presentist's lights, eternalism is trivially false, how can there be an interesting disagreement between the two positions? How can there be a real dispute? But it seems that, as a result of the presentist refusing the distinction between the ontological and temporal-location senses of existence, a real dispute arises, namely whether 'exist' has two readings. For the presentist, "Socrates exists now, but he doesn't exist now," is an abominable conjunction. For the eternalist, that same sentence is perfectly acceptable, because 'exist' has two readings. It seems that, if the presentist refuses the distinction, there is still a genuine dispute.

most unrestricted quantifiers. If this were also to mean that Socrates is present, the consequences for eternalism are disastrous. The poor argument against eternalism above is no longer poor at all. If there is no distinction between the ontological and temporal-location senses of existence, then presuming Socrates exists, we should be able to go to Greece and find him.

How then is the eternalist to make sense of this distinction? At this moment (let's call it time *t*), lots of things exist. There are a vast number of things that exist in the ontological sense at *t*. We can imagine making a huge list with a notation for each of these things. Now, if we make a list of all the things that exist in the temporal-location sense at *t*, this second list will be a sub-list of all the things that exist in the ontological sense at *t.*

It seems there must be some feature that those things on the second list have that the things solely on the first list lack. For something to exist in the temporal-location sense at *t* requires it to have some feature lacked by those things that merely exist in the ontological sense at *t*. What might that feature be? The demand to explain this feature poses a problem for eternalism, and it is a problem with no easy answer.

A WEALTH OF SYNONYMY

There are a number of quick-fixes we might employ to analyze the feature had by those things that exist in the temporal-location sense at a given moment but lacked by those things that merely exist in the ontological sense at that moment. But none of these easy

explanations is ultimately satisfying. When one takes a closer look at any of these quick-fix solutions, he is led right back to where he started.

The first of these solutions has already been suggested in the quotes from Markosian above. The feature is present-ness. Those things that exist in the temporal-location sense at a given moment *t* are present at *t*. Those things that merely exist in the ontological sense at *t* are not. But this is an empty explanation. It leads one to wonder what feature those things that exist and are present at *t* have over those things that merely exist at *t*. One seems led to answer that those things that exist and are present at *t* exist in the temporal-location sense at *t*, while those things that merely exist at *t* exist only in the ontological sense at *t*.[14]

Another obvious failure is to claim that the feature is temporal location. Those things that exist in the temporal-location sense at a given moment *t* are temporally located at *t*. Those things that merely exist in the ontological sense at *t* are not. Again, one can ask what feature those things that exist and are temporally located at *t* have over those things that merely exist at *t*. And the answer seems to be that those things that exist and are temporally located at *t* exist in the temporal-location sense at *t* (or are present at *t*) while those things that merely exist at *t* exist only in the ontological sense at *t* (or exist and are non-present at *t*).

[14] Here, I am not taking "being present at *t*" to be a primitive property possessed by all and only those objects that exist in the temporal-location sense at *t*. If present-ness were such a primitive, it would be illegitimate for me to reject it as a solution to the puzzle by noting that it cannot be analyzed. Similar remarks apply for taking "being temporally located at *t*" or "existing in the temporal-location sense at *t*" as primitive. Claiming such properties are primitive is essentially claiming that temporal location is primitive. And I discuss this response later in the paper.

Yet a third failure is to claim that the feature is that they are in the domain of our quantifiers when those quantifiers are restricted to *t*. Those things that exist in the temporal-location sense at a given moment *t* fall within the domain of our quantifiers when those quantifiers are restricted to *t*. Those things that merely exist in the ontological sense at *t* are merely in the domain of our most unrestricted quantifiers. On the face of it, one might think that this is a satisfactory explanation. No more needs to be said on the issue. But in truth, this reply does not suffice.

Consider what is meant by restricted quantification. Restricted quantification is quantification over some set *d'*, which is a proper subset of some given set *d*.[15] Imagine we start by quantifying over the set of all people. Then, we restrict our quantifiers so that now only men are in their domain. With our quantifiers restricted, we are quantifying over the set of men that is a subset of the set of people. In this case, it makes perfect sense to conclude that men share a feature or features that non-men lack. It makes perfect sense to ask what that feature or those features might be. And this is the very sort of question I pose when I ask what feature do those things that exist in the temporal-location sense at a given moment have that those things that merely exist in the ontological sense at that moment lack.

Claiming the feature is that they are in the domain of our quantifiers when those quantifiers are restricted to *t* does not explain the feature. It takes us again to the usual question. What feature do those things that fall within the domain of our quantifiers

[15] Steven F. Savitt, "Presentism and Eternalism in Perspective," paper presented to the Philosophy of Time Society Meeting, Chicago, IL, March 2004, 8.

when those quantifiers are restricted to *t* have over those things that are merely in the domain of our most unrestricted quantifiers? One cannot answer by appealing to present-ness, temporal location, or existence in the temporal-location sense. And now, our easy answers are used up. The mystery remains. A satisfactory analysis of temporal location is required.

ONE MORE OBVIOUS SOLUTION & WHY IT FAILS

There is another obvious candidate for the feature that those objects that are temporally located at a given moment have that those objects that merely exist at that moment lack. But properly exploring it requires a discussion of the way objects persist through time.

The two most influential views of how objects persist through time are perdurantism and endurantism, which Markosian takes to be synonymous with four-dimensionalism and three-dimensionalism.[16] He defines perdurantism and endurantism this way:

> Perdurantism: Any object that exists at different times has different temporal parts at the different moments at which it exists.[17]
>
> Endurantism: Any object that exists at different times is wholly present at each moment at which it exists.[18]

[16] Markosian, "The 3D/4D Controversy," 1.

[17] Ibid., 2.

[18] Ibid., 1.

Assuming perdurantism, perhaps the feature is having a temporal part. Those things that are temporally located at a given moment *t* have a temporal part at *t*, while those things that merely exist at *t* do not have a temporal part at *t*.

Assuming endurantism, perhaps the feature is being wholly present. Those things that are temporally located at a given moment *t* are wholly present at *t*, while those things that merely exist at *t* are not.

But before exploring whether having a temporal part or being wholly present at a given time explains something's being temporally located at that time, we must consider Markosian's remarks on the 3D/4D debate and the distinction between the temporal-location and ontological senses of existence. Markosian reinforces the need for the distinction between the temporal-location and ontological senses of existence. He puts it as follows:

> The parties to the temporal dispute [must] agree that '*x* exists' and '*x* is present' are not synonymous – non-presentists in order to ensure that their claim is not trivially false, and presentists in order to ensure that their claim is not trivially true. Once the two parties accept that '*x* exists' and '*x* is present' are not synonymous, they can agree that their dispute is over the question of whether these two expressions are always co-extensive.[19]

Here, Markosian has rephrased the distinction between the temporal-location and ontological senses of existence, referring to it as the distinction between present-ness and existence. Given this rephrased distinction, Markosian proceeds to note that the

[19] Ibid., 3.

definitions of perdurantism and endurantism described above entail that non-presentism is trivially false.[20] They force us to deny eternalism.

Recall that perdurantism as defined above is the view that any object that exists at different times has different temporal parts at the different moments at which it exists. Given perdurantism and eternalism, if Socrates exists now, then he has a temporal part now. This would entail that a temporal part of Socrates is a present object and would lead to all the problems Socrates's being a present object creates.

Endurantism, as formulated above, is in the same boat. Recall that endurantism was defined as the view that any object that exists at different times is wholly present at each moment at which it exists. Again, given endurantism and eternalism, if Socrates exists now, then he is wholly present now. This too would entail that Socrates is a present object and would lead to all the problems Socrates's being a present object creates.

Markosian solves this problem by modifying the definitions of perdurantism and endurantism. Relying on these revised formulations, one can accept either perdurantism or endurantism without committing oneself to presentism. His corrected versions of perdurantism and endurantism are as follows:

> Perdurantism (revised): Any object that is present at different times has different temporal parts at the different moments at which it is present.[21]
>
> Endurantism (revised): Any object that is present at different times is wholly present at each moment at which it is present.[22]

---

[20] Ibid., 4.

[21] Ibid., 5.

[22] Ibid.

In essence, Markosian has applied the distinction between the temporal-location and ontological senses of existence to the definitions of perdurantism and endurantism. As Markosian notes, if the notion of existence used in the definitions of perdurantism and endurantism is understood in the ontological sense, then accepting either view renders eternalism false. If, on the other hand, the notion of existence used in the definitions of perdurantism and endurantism is understood in the temporal-location sense, eternalism is spared. What Markosian has shown is that the eternalist must understand perdurantism and endurantism in terms of the temporal-location sense of existence in order for his view to be coherent. This means that the eternalist cannot rely on his notion of perdurantism or endurantism to provide a satisfactory analysis of temporal location because the eternalist's concepts of perdurantism and endurantism rely on the notion of temporal location.

Note that it is not just Markosian's formulations of the views that rest on the notion of temporal location. Sider defines 4D-ism/perdurantism as the view that, given a set of moments the union of which is the time span of *x*, *x* has a temporal part at each moment in the set.[23] By "the time span of *x*," Sider seems to mean the moments at which *x* exists. But does Sider mean the moments at which *x* exists in the ontological sense or the temporal-location sense? If the time span of *x* is to be understood as the moments at which *x* exists in the ontological sense, then Sider's formulation too entails that, if *x* exists now, *x* is a present object. The only way for Sider to avoid this consequence is to

---

[23] Theodore Sider, "Four Dimensionalism," *The Philosophical Review* 106 (1997): 7.

accept that the time span of *x* is to be understood as the moments at which *x* exists in the temporal-location sense. But this means that Sider's formulation too rests on the notion of temporal location. Thus, Sider's notion of perdurantism is likewise useless for providing an analysis of temporal location.

With these considerations out of the way, we return to our original question and our most recent candidate to answer it. What feature do those objects that are temporally located at a given moment have that those objects that merely exist at that moment lack? Assuming perdurantism, is the feature having a temporal part? Assuming endurantism, is the feature being wholly present?

It seems whether or not being temporally located at a given time *t* can be analyzed in terms of having a temporal part or being wholly present at *t* depends on how one defines having a temporal part and being wholly present. Markosian, his formulations inspired by Sider, gives the following account of having a temporal part and being wholly present:

> *x* is a temporal part of *y* at *t* =df (i) *x* exists only at *t*; (ii) *x* is a part of *y* at *t*; and (iii) *x* overlaps everything that is a part of *y* at *t*.[24]
>
> *x* is wholly present at *t* =df (i) *x* is present at *t* and (ii) it's not the case that there is a *y* such that *y* is a temporal part of *x* at some time other than *t*.[25]

In order to see whether these definitions can provide a satisfactory analysis of temporal location, consider first the definition of a temporal part. According to the definition, if something has a temporal part at a given time *t*, then it has a part that exists

[24] Markosian, "The 3D/4D Controversy," 6.

[25] Ibid.

only at *t*. But what kind of existence are we talking about here? Does the part exist only at *t* in the ontological sense, or does the part exist only at *t* in the temporal-location sense? In order for eternalism to be coherent, the part must exist only at *t* in the temporal-location sense.

Presumably, the perdurantist eternalist wants to claim that Socrates does not have a temporal part at the present moment. But he also wants to claim that Socrates is merely an amalgam, a mereological sum, of his temporal parts. If each of Socrates's temporal parts only falls within the domain of our most unrestricted quantifiers at its one particular moment and Socrates is only the combination of his temporal parts, then, since Socrates does not have a temporal part now, he is not within the domain of our most unrestricted quantifiers now. Socrates does not exist now. But of course, this is the very opposite of what the perdurantist eternalist wants to claim.

The perdurantist eternalist must claim that to have a temporal part at *t* is to have a part that is temporally located only at *t*. But this means that the definition of temporal part relies on the notion of temporal location. It is useless for providing an analysis of temporal location.

Recall that we were hoping to understand what it was for an object to be temporally located at a moment *t* in terms of its having a temporal part at *t*. But as has been shown, in order to understand properly what it is for an object to have a temporal part, we must understand what it is for that temporal part to be temporally located at its particular moment. Thus the notion of a temporal part cannot help us find an analysis of

temporal location. The notion of a temporal part relies on the notion of temporal location.

Turning to the definition of the wholly present, the definition includes both the notion of present-ness and the notion of a temporal part.[26] For these reasons, an endurantist eternalist cannot rely on the notion of something's being wholly present at a given moment *t* in order to explain that thing's being temporally located at *t*.

Given the above formulations, one cannot analyze temporal location in terms of having a temporal part or being wholly present. But might one be able to redefine these concepts so as to make them useful for providing such an analysis?

It seems possible that one can redefine having a temporal part and being wholly present in a way that does not rely on the notion of temporal location, but I have not discovered any such formulations myself. Moreover, I expect such definitions will prove quite hard to find. Any satisfactory definition of temporal part-hood needs to be formulated in such a way that a given temporal part cannot be instantiated in more than one moment. Each temporal part must be bound to one particular moment. In order to enforce this constraint, any satisfactory definition of temporal part-hood must require that a given temporal part be temporally located only at one particular moment. It seems very difficult to divorce the concept of temporal part-hood from the notion of temporal location.

[26] Of course, the endurantist denies outright that any object has any temporal parts, but Markosian's definition of wholly present includes the notion of a temporal part in order to specify what it is the endurantist denies that any object has.

It does seem that one could easily define being wholly present without relying on the notion of temporal part-hood. But it seems much more difficult to define being wholly present without relying on the notion of being present. And since one cannot analyze temporal location in terms of any concept that relies on present-ness, analyzing it in terms of being wholly present seems doomed to failure.

Still, I leave it as an open question whether or not a formulation of having a temporal part or being wholly present can be found that could analyze the notion of temporal location.

IS PRESENTISM THE SOLUTION?

On the face of it, eternalism has a problem. Recall that, according to eternalism, in order for a present utterance of, "Socrates was a philosopher," to be true, there must be a time earlier than now at which Socrates is located and at which Socrates is a philosopher. But we have no obvious way of explaining what it is for Socrates to be located at a time earlier than now. We have no obvious way of explaining what it is for Socrates to be located at any time whatsoever.

Of course, we can simply claim that temporal location is primitive. The space-time points that constitute the universe have some kind of unanalyzable organization. So, when we ask what it is for an object to be located at a time, we ask a trivial question, one

answered simply by appealing to the primitive location of the points that constitute the object.[27]

But this very reply creates a problem for eternalism. Recall that one of the major liabilities of presentism was that it required the presentist to be committed to primitive temporal operators. But if the eternalist must take temporal location as primitive, then eternalism too must license questionable primitives. Eternalism has both the unpalatable commitment to the position that time does not pass and to irreducible temporal location.

The eternalist is seemingly faced with a dilemma. He must posit a distinction between an object's merely existing at a time and that object's being temporally located at that time. To do so, the eternalist must either provide an analysis of temporal location or take temporal location as primitive. To provide an analysis of temporal location, the eternalist must explain the feature that temporally local objects have that merely existing objects lack. But there is no obvious explanation of the feature that is not itself synonymous with nor does it rely on the notion of temporal location. Moreover, taking temporal location as primitive forces us to give up the logical economy of primitives that seemed to motivate eternalism over presentism.

Is presentism then the solution? Should we simply give up eternalism and accept presentism?[28] The presentist is not required to make a distinction between an object's existing at a time and that object's being temporally located at that time. For the

[27] Of course, my discussion of temporal location in terms of the organization of space-time points would most appeal to perdurantists who take objects to be sets of space-time points.

[28] Although they would tie when it comes to economy of primitives, overall, presentism would win over eternalism because presentism, unlike eternalism, upholds our intuition that time passes.

presentist, one sense of existence is enough. But before we tell the eternalists to clean out their desks, there is more to consider. A similar problem to the temporal-location puzzle is lurking for both the presentist and the eternalist, but seeing the problem requires a bit of a digression.

The debate between presentism and eternalism as regards time mirrors the debate between actualism and genuine modal realism as regards modality.[29] Markosian defines actualism as the view that, necessarily, there are no non-actual objects.[30] He defines genuine modal realism as the view that, necessarily there are some non-actual objects.[31] Actualism is the analog of presentism. Genuine modal realism is the analog of eternalism.

As we have seen, presentism takes existence in its broadest sense to be existence at the present moment. On presentism, only objects local to the present moment exist. Eternalism must take existence in its broadest sense (the ontological sense) to be distinct from existence at a moment (the temporal-location sense). On eternalism, both temporally distant and temporally local objects exist. But only temporally local objects are temporally located at the present moment. The challenge for the eternalist is finding a satisfactory analysis of what beyond mere existence at a moment is required to be temporally local to that moment.

---

[29] Sider, "Presentism and Ontological Commitment," 1.

[30] Markosian, "The 3D/4D Controversy," 2.

[31] Ibid.

For the actualist, existence in its broadest sense is equivalent to being a part of the actual world. According to actualism, only actual objects exist. But for the genuine modal realist, a multitude of non-actual objects exist. How does the genuine modal realist distinguish those objects that are actual from those objects that are merely possible?

Consider that, for the genuine modal realist, "actual" is an indexical. The actual world is whatever world in which the speaker happens to be located. There is no objectively actual world. In our world, Ted Sider is a philosopher, but he could have been a soccer player. According to the genuine modal realist, in our world, both Sider the philosopher and Sider the soccer player exist, but only Sider the philosopher is actual. Is there any explanation of the feature Sider the philosopher has that Sider the soccer player lacks that is not itself synonymous with nor does it rely on the notion of being actual?

David Lewis provides an answer. Lewis claims that, at our world, the feature that Sider the philosopher has that Sider the soccer player lacks is that Sider the philosopher is spatiotemporally related to us.[32] More specifically, every particular part of Sider is spatiotemporally related to every particular part of you and me. According to Lewis, this makes us worldmates. And since "actual" is an indexical, all that is required to determine the actual objects at our world is to determine our worldmates.

---

[32] David Lewis, *On the Plurality of Worlds* (Oxford: Blackwell, 1986), 70.

However, Lewis's answer requires us to know what it is for an object to be spatiotemporally located at a given place and time. And this is the very question we were trying to pursue when we looked to the debate between actualism and genuine modal realism for inspiration. Either Lewis must take spatial and temporal location to be primitive, or he must provide an analysis of it in order to make sense of his conditions for being worldmates.

If the genuine modal realist is not allowed to rely on the notion of spatiotemporal location to individuate worlds, then he is left with an analog to the temporal-location puzzle. Existence by itself does not entail actuality. Thus, there must be some feature that actual objects have that merely existing objects lack, and (if we disallow an explanation that relies on spatiotemporal location) an explanation of what that feature is proves hard to find.

So, as we have seen, as much as there is a debate between presentism and eternalism as regards time, there is a debate between actualism and genuine modal realism as regards modality. One could simply say that now we should become actualist presentists and thus do away with these problems of temporal and modal location altogether.

But this reaction is too hasty. Consider the underlying similarities of the aforementioned temporal and modal debates. Both the presentist and the actualist claim that to exist at all is to be local. The eternalist and the genuine modal realist claim that things do exist that are not local. It seems that an analog to the presentism/eternalism, temporal debate and the actualism/realism, modal debate can be created for space as well.

We can image two views, spatial presentism and spatial realism. For the spatial presentist, nothing exists beyond that which is here, i.e., that which is local to this particular region of space. For the spatial realist, there is a distinction between existing in the broadest sense and existing here.

To clarify, consider that, at the moment, I am typing in my office in Saint Louis. My brother is watching television in Green Bay. Still, here in my office, my brother exists. My brother falls within the domain of our most unrestricted quantifiers. But my brother is not here in my office. He is not within these four walls. Here in my office, there is some feature that I have that my brother lacks. There is some feature that those objects that are present in my office have that those objects that merely exist in my office lack.

Both my brother and I exist in my office. We are both in the domain of our most unrestricted quantifiers. We just don't both occupy the same sufficiently small spatial region, the region that comprises my office. But how do we distinguish between those existing objects that are local to the small spatial region that is my office and those that aren't? We must posit a feature that the objects in my office have that the objects outside of my office lack. Again, we are left with the same old question. What might that feature be?

Again, there is no easy answer. Being present in my office, being here in my office, being local to my office, and being such that with our quantifiers restricted to my office it still falls within the domain of our quantifiers all seem synonymous. Moreover, it seems that an appeal to the fact that my physical body is in my office will have to rest

on the notion of being present in or being local to my office. It does not seem that there is a satisfactory analysis of spatial location either.

It seems that we have three concepts, modality, time, and space, for which we can construct analogous debates. At issue is the question of whether existence entails being local or whether existence extends beyond the local. If one claims that existence extends beyond the local in every case, he commits himself to realism about merely possible objects, non-present objects, and spatially distant objects. If one claims that existence entails being local in every case, he commits himself to actualism, presentism, and the view that everything exists within some sufficiently small spatial region.

Whether the kind of extreme presentism described in the latter case is even coherent, it is certainly not a view that anyone would hold. So while there are philosophers who take modality, time, and space to be extended, there are none that take modality, time, and space to entail being local. Everyone is a spatial realist.

This means that, if the presentist must take spatial location as primitive, he can hardly begrudge the eternalist for taking spatiotemporal location as primitive as well. But perhaps we do not need to throw up our hands and admit that spatiotemporal location is irreducible. To find an analysis of spatiotemporal location, we must begin by asking ourselves some simple questions.

ORGANIZING SPACE-TIME

What do we mean when we ask what is it for an object to be located at a time? If we're eternalists, we take time to be an extended manifold of space-time points. If we're

presentists, we take time to be a momentary slice of space-time points. On eternalism, when we say that Socrates merely exists at *t*, we're saying that, no matter whether and how we may choose to restrict our quantifiers, Socrates always falls within the domain of our most unrestricted quantifiers.

On eternalism, when we say that Socrates is located at *t*, we are really saying a number of things: 1) We're restricting our quantifiers to some subset of existing space-time points, which falls within the domain of all existing space-time points. 2) We're calling this subset of points that our restricted quantifiers range over "the moment *t*," and 3) we're claiming that some or all of the space-time points that constitute the object Socrates are a part of *t*; that is, the points that make up Socrates are among the points that fall within the domain of our restricted quantifiers.

On presentism, we don't have an extended manifold of space-time points. All we have is one moment or time-slice of points. When we ask what is it for Socrates to be present at the moment *t* (to be located at *t*), we are not restricting our quantifiers to a subset of existing space-time points, falling within the domain of all existing space-time points. When we ask what it is for Socrates to be present at *t*, we leave our quantifiers wide open. For Socrates to be present at *t* is merely for the space-time points that constitute Socrates to fall within the domain of our most unrestricted quantifiers. For the presentist, there is no difference between existence at a time and existence *simpliciter*.

But for the eternalist, there is a difference. On eternalism, there is a distinction between those things that are temporally located at a time and those things that merely exist at that time. On eternalism, when we ask what feature or features does Socrates

(who is located at *t*) have that Sider (who merely exists at *t*) lacks, again we ask a number of things: 1) We ask what it is about the points that constitute Socrates that make them a part of the set of points that make up *t*. 2) We ask what it is about the points that constitute Sider such that they are not part of the set of points that make up *t*. 3) We ask what feature differentiates the space-time points that fall within the domain of our quantifiers when they are restricted to *t* from those points that do not fall within that domain.

In essence, eternalism assumes, we have a nicely arranged, well organized manifold of space-time points. When we restrict our quantifiers in order to talk about a moment of time, we're picking out a subset, a time-slice, of all the moments in that manifold. The question is what is the organizing principle, if any, behind that manifold.[33]

In order to help us get a grip on the project we're undertaking, it may be useful if we envision all the points of space-time as a collection of beads. We can imagine the organizing principle behind the space-time points as strings that connect them. Much as all the space-time points are connected by this organizing principle, all the beads are connected to one another by strings. Now, if we pull the strings tight, what would have been a disorganized mess of beads becomes nicely arranged into a manifold. There is a place for every point, and every point is in its place.

[33] In what follows, I attempt to analyze the organizing principle behind the space-time points that comprise the universe. In providing an account of how the space-time points that comprise the universe are arranged, I provide an account of the spatiotemporal location of and the spatiotemporal relations between the objects the points comprise. I do not attempt to analyze space-time itself. I take the existence of the space-time points to be primitive in the same way I take the existence of the objects that the points comprise to be primitive. The space-time points simply fall within the domain of our most unrestricted quantifiers, and that is all I intend to say on the issue.

If we take spatiotemporal location as primitive, we're essentially claiming that there is some unanalyzable organization to the space-time points that constitute the universe. When we quantify over a part of the space-time manifold, we are able to take the organization of the manifold for granted. We are able to rely on the organization of the manifold as a way of differentiating between those points that our restricted quantifiers range over and those that they don't.

If we refuse to take spatiotemporal location as primitive, then we have to devise some means of organizing the space-time points that constitute the universe. Our challenge becomes taking our disorganized collection of points and finding some way of arranging them into the proper manifold without relying on primitive spatiotemporal location.

Imagine again that the space-time points that make up the universe are represented by beads. If we take spatiotemporal location as primitive, then we have strings to connect the beads, and thus it is easy to arrange properly our beads into their manifold structure. But if we refuse to take spatiotemporal location as primitive, then if we have all of the space-time points that exist *simpliciter*, we know nothing about how they are arranged. All we have is a disorganized pile of beads.

Without primitive spatiotemporal location, we must find some other way of connecting our objects, a way that nonetheless allows us to arrange the objects in the same structure in which they would have been arranged had we taken spatiotemporal location as primitive. We must take our beads and arrange them in the same way as before, without relying on the irreducible-organizing-principle strings to connect them.

The search for a principle by which to organize the points in space-time leads us to another simple question. Why am I here? Or rather, why are the space-time points of which I am comprised adjacent to the space-time points to which they are adjacent? Right now, I am in my office typing a philosophy paper. If you were to ask me why I am in my office, my commonsense reply would be that I'm in my office because awhile ago I walked into my office. It seems there is something about my past state that caused my current state. Causation seems to govern the arrangement of the objects in space and time.

So, our commonsense understanding of what makes an object where it is seems to be that an object is where it is now because it was caused to be there by some other object in the past. Perhaps, the causal relations between space-time points can be used to organize those points into the proper manifold arrangement. The question then becomes how we characterize these causal relations so that they allow us to arrange their *relata* into the proper manifold structure.

It may help to focus on a single causal relation rather than a whole universe full of them. Or rather, it may help if we focus on a universe containing only two objects. Imagine two points in space-time P and Q. P causes Q. And if we were to take spatiotemporal location as primitive, our universe would be organized such that Q occurs one moment after P. But without primitive spatiotemporal location, we only have P, Q, and the fact that P causes Q. We have to characterize the causal relation between P and Q in such a way that P and Q must as a consequence of their causal connection be organized in a certain way relative to one another.

How then are we to characterize this causal relation? In order for causation to allow us to provide an analysis of spatiotemporal location, we must first say that P and Q share a necessary connection and that one of the consequences of that connection is that the space-time point that constitutes P is arranged in a certain way relative to the space-time point that constitutes Q. In this case, they are adjacent. "P causes Q," should be taken to mean that, necessarily, P exists iff Q exists and, necessarily, where P and Q exist, P is arranged in a certain way relative to Q.[34] Essentially, we are grounding non-modal facts, i.e., facts about spatiotemporal location, in terms of modal facts, i.e., causation understood as a necessary connection between objects/space-time points.

So, returning to our P-and-Q universe, if we took spatiotemporal location as primitive, our universe would consist of two objects P and Q. It would span two moments. And P would be temporally located at the first moment, while Q would be temporally located at the second. Now, denying that spatiotemporal location is primitive, our universe still consists of two objects P and Q. If P causes Q in the manner described above, then wherever P exists, Q must also exist. Moreover, P and Q must be organized in a certain way. They are organized such that from that organization we could derive the spatiotemporal relation between them as being one moment apart. Thus, our universe consists of two objects P and Q. It spans two moments. And P is temporally located at the first moment, while Q is temporally located at the second.

[34] P and Q must both exist in the ontological sense. They must both fall within the domain of our most unrestricted quantifiers.

If P and Q were temporal parts of the same object, then the causal analysis of temporal location above would explain what it was for that object to perdure through time. An explanation of an object's enduring through time would work similarly.

Of course, to say that P shares a necessary causal connection with Q, while accurate, is not a full explanation of the connection between them. I do not want it to be the case that every object that superficially resembles P is necessarily connected to every object that superficially resembles Q.

Assume for the sake of simplicity that every object is merely a bundle of co-instantiated properties.[35] Some of an object's properties will be accidental to it, while others of its properties will be essential to its being the kind of object it is. Now, I claim that for an object P to cause an object Q is for P to share a necessary connection with Q. That is, P exists iff Q exists and, necessarily, where P and Q exist, P is arranged in a certain way relative to Q. By this, I mean that P's essential properties are such that, necessarily, they are co-instantiated iff there is also another bundle of co-instantiated essential properties Q. Moreover, these two bundles of properties must be arranged in a certain way relative to one another. P and Q's arrangement supervenes on P and Q's essential properties. That is, the space-time points that constitute P and Q are organized in the way they are because of P and Q's essential properties. One cannot modify their arrangement without modifying their essential properties.

[35] For a discussion of bundle theory, see James Van Cleve, "Three Versions of the Bundle Theory," *Philosophical Studies 47* (1985), 95-107.

To illustrate, consider an object in space-time. That is, consider the set of space-time points that constitute an object, and consider the space-time points that surround it. The object causes space-time to curve.[36] That is, the points that constitute the object have the property mass. Wherever an object with that mass exists, it must exist in space-time, and the space-time must have a certain curvature. Again, that is, where a set of space-time points with mass are organized so as to constitute the object, there must be other space-time points arranged so as to surround them. And these surrounding space-time points must have the property of having a certain curvature. This means, if an object exists with this mass, then it must exist in a curved space-time. And it means if there is a space-time with this curvature, there must be in proximity an object with the requisite mass.[37]

Mass is an essential property of the space-time points that constitute the object, and so it is relevant to how the object curves space-time. Curvature is an essential property of space-time points surrounding the object, and so the curvature is relevant to the masses of the objects within it.[38] But accidental properties, like the color of the

---

[36] Jose Wudka, "The General Theory of Relativity," <http://phyun5.ucr.edu/~wudka/Physics7/Notes_www/Pdf_downloads/7.pdf>, 19.

[37] The fact that I focus on a gravitational example, i.e., mass causing a curve in space-time, to illustrate my characterization of causation should not lead the reader to assume that I take gravity as the only causal mechanism relevant to determining the organization of space-time. Gravitational causal relations are just one of many types of causal relations necessary to arrange the points that comprise the universe into the proper manifold structure. Consider again my question of why I am now in my office. I answered that I am now in my office because my past part walked into my office. The causal relation between my past part and my current part is certainly relevant to the organization of the space-time points that comprise me.

[38] I'm assuming here that curvature is an essential property of all space-time points, so curvature will also be an essential property of the points that constitute the object. I trust science supports this assumption, but if science does not, this fact more reflects a poor choice of example on my part than a poor analysis of spatiotemporal location.

object, are irrelevant to how the object curves space and likewise irrelevant to the object's spatiotemporal location.

It may here be objected that causal relations can generally be construed in one of two ways: 1) The cause makes a differences as to whether the effect obtains. 2) The cause transfers energy to the effect.[39] Which of these two ways of construing causation am I opting for in my discussion? I opt for a difference-making account. Consider again the above example. The object's having the mass that it does causes the space-time points around it to curve. The curve in space-time is different as a result of the mass of the object. The differences to the intrinsic properties of the effect as a result of the cause may be subtle, even imperceptibly so, but I maintain that, where an object is causally related to another, it makes a difference to the intrinsic properties of that other nonetheless.

With the notion of a causal relation as described above at our disposal, we now return to our analysis of spatiotemporal location. Recall that we can envision all of the space-time points in existence as beads. Then, assuming that spatiotemporal location is primitive, we can envision the principle of organization that results as strings connecting the beads. By pulling the strings tight, every space-time point in existence becomes properly arranged into a manifold.

Now, we were trying to find a way of producing that same manifold arrangement without the aid of primitive spatiotemporal location, relying instead on causal relations.

[39] See Jonathan Schaffer, "The Metaphysics of Causation," < http://plato.stanford.edu/entries/causation-metaphysics/>.

In terms of our simple two-object world, we were able to create the proper arrangement of P and Q by taking causation to be a kind of necessary connection, but what happens when we increase the complexity of the world?

Imagine now that we have what the eternalist would tell us is the set of all the space-time points that exist in the actual world. This means we're taking existence in the broadest possible sense (the ontological sense) to be distinct from existence restricted to some subset of the points (the temporal-location sense). This set of points shows no organization whatsoever.

If we envision the space-time points again as beads, it is simply a disorganized mess of beads. We must arrange the points into the proper manifold without reference to spatiotemporal location. So, if we understand causation as described above and make a few additional assumptions, we can completely produce the proper manifold arrangement without relying on primitive spatiotemporal location.

But what assumptions do we need to make this causal analysis of spatiotemporal location work? First and most importantly, we need to know what causes what. That is, we need to take the causal relations between space-time points as primitive modal facts.[40] Second, we need to assume that all causation proceeds in the same direction. There is no backwards causation, or put better, the space-time points are organized in the direction of causation.

[40] Or put better, we need primitive modality in that we cannot analyze the necessity of the connection between space-time points in terms of concrete possible worlds individuated by primitive spatiotemporal location.

With these assumptions in place, if the causal interaction between space-time points in the world is rich enough, then by relying on the causal relations between points, we can arrange our disorganized mess into the proper manifold structure. The question then becomes whether the web of causation is rich enough to provide us with the proper manifold arrangement.

In our discussion of the two-object, P-and-Q universe, we noted that, if P and Q were temporal parts of the same object, then we would know what it is for that object to perdure through time. So if we chart the arrangement of the space-time points that make up the temporal parts of our P/Q object, we will have a sort of diagram of that object's path through space-time, its worldline. So returning to the complex actual universe, for all of the objects whose temporal parts are causally related, we can, in the same way we charted the worldline of our P/Q object, chart those object's worldlines. What we need, in order to produce the proper manifold structure, is sufficient causal connections between the different worldlines so that we can know how every worldline is arranged relative to every other.

Now, our goal has been to devise an organizing principle for the points of space-time so that we need not take spatiotemporal location as primitive. We've latched onto causal relations as described above as the means to arrange the space-time points into the proper manifold structure. We've noted that, for any objects whose temporal parts are causally related, the space-time points that constitute those parts will be causally related. And by charting the arrangement of these points, we can diagram these objects' worldlines. To connect these worldlines and thus to create the proper manifold structure,

we need causal relations between the space-time points that constitute the objects and the space-time points that surround them.

The general theory of relativity provides us with an account of how the space-time points that constitute objects with mass are causally connected to the unoccupied space-time points around them. It also provides us with an account of how those unoccupied space-time points are causally connected to the objects they surround. Put simply, the general theory of relativity (GTR) states, "The curvature of space…is generated by the mass of the bodies in it. Correspondingly, the curvature of space determines the trajectories of all bodies moving in it."[41]

If this sketch of GTR is correct, then that will provide us with a means of connecting our disparate collection of worldlines.[42] The objects with mass will cause changes in the surrounding space-time, and the curvature of space-time will cause changes in the objects within it. Appealing again to GTR, "Matter tells space-time how to curve and space-time tells matter how to move."[43] It seems, according to GTR, there is sufficient causal interaction to connect all of the worldlines and thus to produce the proper manifold structure. Causal interaction can serve as the organizing principle of space-time.

---

[41] Wudka, "The General Theory of Relativity," 24.

[42] If this sketch of GTR is incorrect, that does not itself demonstrate that causal relations do not/cannot serve as the organizing principle for our space-time points. My hope is that science, as manifested by GTR, supports something like my proposal. But if I have misconstrued GTR, that nonetheless leaves it open that science may still discover sufficient causal interaction so that causation may serve as the organizing principle of space-time.

[43] Ibid., 19.

BREAKING RANKS

But what if the causal interactions were not so rich? What if there were isolated worldlines or isolated clusters of worldlines? Assume that ours is a world where the causal interactions are not sufficiently rich. There are clusters of space-time points that are not causally related to one another. And so, while we may have an organized manifold for each of our clusters, we have no way of knowing how these clusters fit together.

There would be no way of distinguishing our world from a world containing two spatiotemporally disconnected space-times. We cannot, as Lewis does, simply deny the possibility of spatiotemporally disconnected space-times within a world.[44] Even if we denied it, that would tell us nothing about how our disconnected manifolds fit. It would only tell us that they have to fit.

Our best response is to simply admit what Lewis denies. In a world where the causal interaction is impoverished enough to leave us with disconnected clusters of worldlines, we simply have a world with disconnected space-times.[45] What we must deny is the possibility of a world in which the causal interactions leave us with disconnected manifolds but where those manifolds are still part of the same space-time.

---

[44] Lewis, *On the Plurality of Worlds*, 71-72.

[45] Note that it isn't essential to my view that we accept the possibility of disconnected space-times within a world. I merely claim that, where the causal interaction within a world is not rich enough to provide us with one connected manifold, we have disconnected space-times within that world. It is still open to us to claim that there is no world in which the causal interaction is insufficiently rich.

Is this denial problematic? On the face of it, it certainly seems like we can imagine casually disconnected objects within the same space-time. Imagine a world containing only two spheres. These spheres are separated by an immeasurable distance in space, but nonetheless they are part of the same space-time. Moreover, these spheres do not interact at all. The state of the former sphere makes no difference to the state of the latter sphere. Isn't this an entirely possible state of affairs?

I must maintain that it isn't. First, what would be the difference between these spheres being part of the same space-time and these spheres being part of two disconnected space-times? One might reply that, in the former case, we could travel between the spheres if we were placed within that space, but in the latter case, we couldn't. But by this very reply, we begin inserting other objects (people, rocket ships, or whatever other paraphernalia we'd need to bridge the gap) into our space, and this would increase the amount of causal interaction in the world. By the very circumstance we'd posit to show that the spheres were in one space, we might inadvertently posit sufficient causal interaction to connect the spheres into one manifold.

Second, if these spheres are the same sort of objects that are in our world, then they are going to have mass. And if the space in which these spheres are placed is the same sort of space-time that is in our world, then that space-time is going to curve.[46] Recalling GTR, it seems like the two depressions in space-time that result from the masses of the objects will make a difference to one another, even in a way that is hardly

[46] Wudka, "The General Theory of Relativity," 24.

perceivable. If they were to interact in this way, then we would again have sufficient interaction to connect the spheres into one manifold.

All of this is just another way of denying that the circumstance in which the causal interactions leave us with disconnected manifolds but where those manifolds are still part of the same space-time is possible. But at least it should serve to make that denial seem more plausible. Where we have insufficient causal interaction such that our picture of causal relations yields two disconnected manifolds of space-time points, we have two spatiotemporally disconnected space-times. In a way, by accepting the possibility of disconnected space-times within a world but denying the possibility of disconnected causal manifolds within the same space-time, we have turned a seeming weakness into a strength. Lewis grants that the possibility of disconnected space-times within a world is plausible.[47] We have seen that the possibility of disconnected causal manifolds within a space-time isn't.

But with the very remarks I use to show that the denial of the possibility of disconnected causal manifolds within a space-time is plausible, I illustrate another objection to my view. I have been claiming, hopefully bolstered by GTR, that the mass of an object causes a curve in space-time. On my characterization of causation, that means that there is some necessary connection between mass and curvature. But isn't it possible that an object has mass without the space-time around it curving? If I accept that the fact that an object's mass causes space-time to curve is among our primitive modal facts, I must insist that it isn't.

---

[47] Lewis, *On the Plurality of Worlds*, 71.

Again, on the face of it, we can imagine a world in which there is a sphere with the same sort of mass that objects in our world have. Yet we can also imagine that the space-time points that constitute that sphere are not surrounded by other space-time points, i.e. it is not in space-time, or it is in a space-time that does not curve. Certainly, it seems like such a state of affairs is possible. But, I have to deny this possibility.

Should we be concerned about this? Again, I maintain that we shouldn't. Consider the circumstance in which a sphere with the same sort of mass that objects in our world have is in a space-time of the same sort as our space-time. Nonetheless, this space-time does not curve. I must refuse that this state of affairs is possible. But I can accept the possibility of a sphere with a property very much like mass (fool's mass or pseudo-mass) in a space-time that does not curve. This space-time is not the sort of space-time as the one in our world either, but it too is very similar to our own. I must claim that, when we envision the circumstance that I refuse and deem in possible, what we really envision is the circumstance that I accept.

Yes, an object with mass could not exist outside of space-time nor could it exist in a non-curved space-time. But an object with pseudo-mass could exist outside of space-time, or an object with pseudo-mass could exist in a pseudo-space-time that was not curved. Our powers to differentiate between mass and pseudo-mass might not be so well honed that we can deny the necessary connection between mass and curvature based on our ability to conceive of circumstances where this connection does not hold alone.

Now, to talk about an object that is temporally located at a time *t* requires us to quantify over *t*. On eternalism, we must restrict our quantifiers so that only a subset of all

the space-time points in existence falls within those quantifiers' domain. The question then becomes how we differentiate between those space-time points that fall within the domain of those restricted quantifiers from those space-time points that merely fall within the domain of our most unrestricted quantifiers. Put better, is there a principle of organization behind the space-time points in the universe such that we can appeal to it as a means of distinguishing the space-time points that comprise *t* from those that don't.

We suggested that the causal relations between space-time points may provide the principle by which we can arrange those points into the proper manifold structure. But there are a handful of issues stemming from the means by which I described the proposal which bear addressing here.

First, in my characterization of a causal relation, I noted that for, any two space-time points P and Q, if P is causally related to Q, then necessarily P exists iff Q exists and necessarily, where P and Q exist, P is arranged in a certain way relative to Q. Now, it may sound, when I say that P is arranged in a certain way relative to Q, as if I am trying to place space-time points P and Q within some other space-time manifold. Moreover, when I appeal to the certain arrangement P bears to Q, it sounds like I'm appealing to some kind of primitive spatiotemporal relation.

But this is not so much a problem for my view as it is an artifact of the method I used to describe it. It helps us understand the project if we visualize P and Q as beads and the causal connection between them as some kind of tether; that is, if we spatialize the principle of organization between them. But when we talk about the principle of organization between space-time points P and Q, we're not truly trying to arrange them

within some other space-time manifold. There is no other manifold that undergirds the space-time points. All there is is space-time points. That is, I'm taking the universe to be comprised of the space-time points and nothing more.[48]

Moreover, the arrangement between the points is simply a means of articulating the principle of organization between them. It is not a spatiotemporal relation. Spatiotemporal relations arise from the principle of organization between the space-time points, and the principle of organization is nothing but the causal connections between the points.

Second, in trying to discover the principle of organization behind the space-time points, I seemed to assume that every space-time point was a mereological simple. For any space-time point, it's impossible to divide that point into smaller points. This may or may not be a fair assumption, but it is one we do not need to make.

Imagine that for any space-time point, we can divide that point into a collection of smaller points. Imagine space-time is gunky. Much as the larger points with which we started participate in causal relations that organize them, so too will the smaller points participate in causal relations that organize them. The same way that causal relations can serve as the principle of organization behind mereological simple space-time points, they can also serve as the principle of organization behind gunky space-time points.

Finally, there is a question of how we determine what constitutes a moment on my view. Presuming eternalism, we said that a moment *t* is a subset of all the space-time

[48] Recall that I am not attempting to analyze space and time itself. I am attempting to analyze spatiotemporal location. I take the existence of space-time points to be primitive the same way I take the existence of the objects that the space-time points comprise to be primitive.

points that exist *simpliciter*. Granting that causal relations serve as the principle of organization that arranges the space-time points, we can appeal to this organization in differentiating which points are members of the subset and which points are not. If we spatialize the organization between the points again, there is a question of how thick a time-slice of points constitutes a moment. Is a moment only one space-time point thick, or is it more than one space-time point thick?

I take this to be a separate philosophical issue from the one that forms the core of this paper. But if space-time is gunky, obviously moments will be infinitely many points thick. If space-time is atomic, then moments may be only one point thick. I take it to be really a question of how many points we want to quantify over when we talk about a moment. And that is a separate question from how the space-time points are arranged. No matter how we decide the issue of what constitutes a moment, we will be able to appeal to the principle of organization behind the space-time points in order to determine what points are local to that moment and what points are not.

ORGANIZATION UNMOTIVATED

Of course, there is major objection waiting in the wings. Why bother to discover an organizing principle between the space-time points at all? Claiming that the organization between them is primitive has its advantages. Moreover, grounding the organization between space-time points in terms of causal relations has its disadvantages. Even if my view is coherent, perhaps it is unmotivated.

Consider the analysis of causation that arises from Humean reductionism. According to Humeanism, modal facts supervene on non-modal facts.[49] That is, facts like the laws of nature and the counterfactual structure of the world supervene on facts about the distribution of perfectly natural properties within the world.[50]

We take the distribution of these properties to be primitive. We take as given the "pattern of instantiation of space-time points of perfectly natural monadic properties, together with the facts about the spatiotemporal relations among those points."[51] From this distribution, we posit the system of natural laws that provides us with the simplest and yet most informative representation of the regularities within that distribution.[52] Then, from this set of natural laws and the distribution, we fix the counterfactual structure of the world, thus fixing what causes what.[53]

In essence, we reason from the primitive spatiotemporal location of the space-time points to the causal relations between them. Now, I have been arguing that we should proceed in the other direction. We should reason from the causal relations between space-time points to their spatiotemporal locations.

On first blush, there seems to be no reason why it should be any worse to infer in the direction I prefer instead of in the direction the Humean prefers. But the Humean will

---

[49] Ned Hall, "Humean Reductionism About Laws of Nature," paper presented to the Arizona Ontology Conference, Tucson, AZ, January 2007, 4.

[50] Ibid., 6.

[51] Ibid., 5.

[52] Ibid., 12.

[53] Ibid., 2.

note that we have epistemic access to the distribution of space-time points. We can look and feel and perform experiments to determine the position of objects in space-time. So I will have to agree with the Humean that we must discover the laws (and thus what causes what) via looking at the patterns in the distribution of space-time points. The Humean is simply taking our agreed upon epistemic standards and elevating them to the metaphysical standards by which we constitute the laws of nature.[54]

So, I'm already giving ground to the Humean in that I must assent to learning the laws of nature in his way. Isn't it epistemically responsible of me then to grant that laws of nature are constituted in his way? Moreover, in characterizing the causal relations between space-time points, I described them as a necessary connection between points. The phrase "necessary connection" doesn't exactly have a positive connotation in philosophy. Lewis describes such necessary connections as "magical," and he doesn't mean it in a good way.[55]

What's more, Lewis needs primitive spatiotemporal location to play a role in his genuine modal realism. The asset of genuine modal realism is that it allows us to analyze modality. On genuine modal realism, modality becomes quantification.[56] We do not need to rely on primitive modal operators.

In order for my analysis of spatiotemporal location to succeed, I must rely on primitive modality. Genuine modal realism is incompatible with my analysis of

---

[54] Ibid., 16.

[55] Lewis, *On the Plurality of Worlds*, 191.

[56] Ibid., 5.

spatiotemporal location. Genuine modal realism, as Lewis describes it, assumes as primitive concrete worlds much like ours, where spatiotemporal location is simply assumed as primitive.

Not only does Lewis assume primitive spatiotemporal location, he also relies on it to individuate worlds. Lewis says, "A world is a mereological sum of all the possible individuals that are parts of it, and so are worldmates of one another."[57] And Lewis also says, "[F]or any two possible individuals, if every particular part of one is spatiotemporally related to every particular part of the other that is wholly distinct from it, then the two are worldmates."[58] If he did not appeal to the spatiotemporal relations between objects, Lewis would be forced to posit a primitive worldmate relation.

Since we look for our theories to posit as few primitives as possible, it seems that my treatment of spatiotemporal location is at a decisive disadvantage. I am forced to appeal to primitive modality and a primitive account of what causes what in order to provide an analysis of spatiotemporal location.[59] The Humean genuine modal realist needs only appeal to primitive spatiotemporal location in order to analyze modality, laws of nature, and causation. If we were to do a cost/benefit analysis of the two views, it seems that mine would offer a smaller return of philosophical utility for a larger investment in commitment to primitives. My view seems unmotivated.

---

[57] Ibid., 69.

[58] Ibid., 70.

[59] To be perfectly accurate, since I've analyzed causal claims as modal claims, I only really need primitive modality. But it's important to note that causal connections, as I've characterized them, are necessary connections.

Moreover, it won't do to defend my view to claim that it will at least allow the eternalist to maintain the economy of primitives that motivated his view over presentism. It may be true that the eternalist must make a distinction between existence in the ontological sense and existence in the temporal-location sense. It may be true that the presentist need not make this distinction. And it may be true that analyzing spatiotemporal location as I've proposed allows the eternalist to make sense of the distinction between the ontological and temporal-location senses of existence without resorting to primitive spatiotemporal location. But simply because the presentist did not need to make the distinction does not leave the presentist unscathed by the puzzle of analyzing location.

Recall that, as much as the eternalist has the problem of analyzing temporal location, the presentist has the problem of analyzing spatial location. So if the presentist must posit spatial location as among his primitives, he can hardly begrudge the eternalist from positing spatiotemporal location among his primitives. Appealing to my view as a means to advance the debate between presentism and eternalism alone fails to motivate it.

To make a case for my view in the face of the challenge from Humeanism and genuine modal realism, let's start by considering Humeanism. First, I must grant that that Humean is right about how we should come to learn the laws of nature and thus what causes what.[60] We must start by investigating those facets of the world to which we have

[60] I must grant that the Humean has the correct epistemic standards, but I can kvetch that the Humean has no more access to the distribution of natural properties and spatiotemporal relations among space-time points across all times (he only has access to a fraction of times) than I have to the connection between space-time points across worlds.

access, namely the arrangement of space-time points and the distribution of properties within them.

Yes, investigating the laws of nature in this way is epistemically responsible. But is elevating our epistemic standards to the standards that constitute a law metaphysically responsible? The Humean objects that there is something magical about the notion that objects or events share a necessary connection. It's much more reasonable to accept that the disconnected space-time points simply have some distribution. And from the patterns and regularities that occur within that distribution, we then infer generalizations about the natural laws and about what causes what.

But isn't it equally magical to assume that there is no analyzable principle of organization behind the distribution and yet there are discernable patterns and regularities within it. What is more unreasonable: 1) That certain events are connected and that that connection explains why they occur in a patterned way, or 2) That events occur in a patterned way and that that pattern allows us to posit a connection between them?

Metaphysically speaking, there seems to be no reason to prefer the latter to the former. Yes, it is fishy if we posit some unexplainable connection between events, but it's equally fishy if we posit some unexplainable pattern in the distribution of events. It seems that in the question of whether the Humean's view is preferable to my own, we have reached a stalemate.

The issue then turns on genuine modal realism. As we noted earlier, my proposal for analyzing spatiotemporal location and genuine modal realism are incompatible. We cannot analyze spatiotemporal location in terms of necessary causal connection if we

analyze necessary causal connection in terms of spatiotemporal location. If we accept genuine modal realism as an analysis of modality, we cannot accept causation as the principle of organization between our space-time points. The question then becomes whether we should accept genuine modal realism.

Recall that genuine modal realism is the competitor to actualism. Actualism is the view that, necessarily, there are no non-actual objects.[61] That is, the only objects in existence are the objects in the actual world. Genuine modal realism is the view that, necessarily, there are some non-actual objects.[62] That is, there are other objects in existence than just those in the actual world, and those existent but merely possible objects make up a plenitude of existent but merely possible worlds.

All these merely possible objects and merely possible worlds go a long way toward padding the totality of objects in existence. And it is this expansive ontology that has made genuine modal realism seem problematic. Most philosophers have taken these ontological commitments to be too great a cost and have thus opted for some form of actualism.

Among actualists, there are those who simply take modality as primitive and those who try to analyze modality via abstract possible worlds. Unlike the possible worlds posited by the genuine modal realist, abstract possible worlds are not of the same kind as the actual world. They are abstract representations of how other worlds might be.

---

[61] Markosian, "The 3D/4D Controversy," 2.

[62] Ibid.

Lewis distinguishes between three ways in which abstract possible worlds might represent possible states of affairs: 1) Linguistic, on which abstract worlds represent via the meanings of words of which they are constructed. 2) Pictorial, on which abstract worlds are like pictures that represent by isomorphism. 3) Magical, on which abstract worlds simply represent as part of their nature.[63] Lewis proceeds to show that each of these ways still commits one to primitive modality.[64] So in essence, the debate between actualism and genuine modal realism is the debate between whether we can/should analyze modality or whether we must/should take it as primitive.

Lewis takes his genuine modal realism to provide an analysis of modality. According to Lewis, if we accept the genuine modal realist's program, we can analyze all modal statements by quantifying over possible worlds. Is Lewis right about this? To see, we need to examine his definition of a possible world.

According to genuine modal realism, a possible world is "a mereological sum of all the possible individuals that are parts of it, and so are worldmates of one another."[65] The possible individuals are the parts that together comprise the whole mereological sum. But "the part-whole relation [of a mereological sum] is analogous to the member-set relation in the following ways: wholes are individuated by their parts; they necessarily exist if their parts do; and they have whatever parts they do essentially."[66] This constraint

---

[63] Lewis, *On the Plurality of Worlds*, 141.

[64] Ibid., 136-191.

[65] Ibid., 47.

[66] Van Cleve, "Three Versions of the Bundle Theory," 96.

means that every world exists iff its parts do. And it means that every object must have its worldmates essentially. Now, on genuine modal realism's analysis of modality, it is not the case that every object has its worldmates essentially.

Consider that Sider and I are worldmates in the actual world. Every part of Sider and I are spatiotemporally related to one another. Is it possible, according to genuine modal realism, that Sider and I are not worldmates? Yes. It's possible that Sider and I are not worldmates if the following condition is met: There is a world that contains a counterpart of Sider, but it does not contain a counterpart of me. Certainly, the genuine modal realist must grant that this condition is met. I am obviously a contingent being, and Sider can obviously exist independently of whether I exist.

How then is the genuine modal realist to reconcile his analysis of modality with its failure to uphold the requirement that the possible worlds have their parts essentially? He can deny that there is some other possible world in which Sider exists but I don't. This is hardly an appealing option. Or, despite his analysis of most modal claims, he can simply posit a *sui generis* law stating that every possible world must have exactly the parts that it has.[67] But by positing this law, the genuine modal realist resorts to primitive modality.

By positing this law, the genuine modal realist asserts that, necessarily, every object has exactly the worldmates that it does. But the genuine modal realist cannot analyze "necessarily" here as his treatment of modality suggests. He cannot because, for

[67] Yes, the law I insist that the genuine modal realist must posit is already an axiom of set theory. But since it is an axiom of set theory, the genuine modal realist's analysis of modality must uphold its truth.

any two contingent objects that are worldmates, the former will have a counterpart that is not spatiotemporally related to any of the latter's counterparts.[68] The genuine modal realist's analysis of modality would not uphold the truth of the claim that every object has its worldmates essentially. Thus, in order to uphold the truth of this claim, the genuine modal realist must resort to primitive modality. On the face of it, it seems the genuine modal realist doesn't really analyze modality after all.

Now, I've mounted this attack on genuine modal realism in order to motivate my analysis of spatiotemporal location. Recall that genuine modal realism takes spatiotemporal location as primitive, both as a means to individuate worlds and as a means to analyze modal claims. I resort to primitive modality to analyze spatiotemporal location in terms of necessary causal connection between space-time points.

The question becomes, if the genuine modal realist cedes that there is primitive modality in order to answer my objection, is his view still motivated over my own? I claim that it isn't. For the genuine modal realist, taking spatiotemporal location as primitive seemed motivated by the fact that doing so allowed one to analyze modality. But if the genuine modal realist must subscribe to primitive modality, his view begins to seem unmotivated. By taking modality as primitive, I can analyze spatiotemporal location. By taking spatiotemporal location as primitive, he cannot analyze modality.

Moreover, even were my argument against genuine modal realism to fail, there is still the problem of the genuine modal realist's ontological commitments. As Lewis argued, if one is to be an actualist of any stripe, he will have to accept primitive modality.

[68] I'm assuming here that the two contingent objects are such that one can exist independently of the other.

Thus, if one rejects genuine modal realism because of its expansive ontology, one must bring onboard primitive modality. And it is in primitive modality that my analysis of spatiotemporal location has root.

So recall the challenge from Humeanism and genuine modal realism. My analysis of spatiotemporal location seems unmotivated because, by positing primitive spatiotemporal location, we can analyze both causation and modality. I have shown that Humeanism and my analysis of spatiotemporal location are on equal footing. I am able to explain why there is a pattern to the arrangement of space-time points at the expense of not analyzing causation.[69] He is able to explain causation at the expense of not analyzing why there is a pattern to the arrangement of space-time points.

I have also shown that genuine modal realism is at a disadvantage against my analysis of spatiotemporal location. The genuine modal realist must accept an expansive ontology and primitive spatiotemporal location. Moreover, it's questionable whether his view really provides an analysis of modality. I must merely accept primitive modality. An analysis of spatiotemporal location follows from there. It seems my view is motivated after all.

FINAL REMARKS

So to recap, the presentist claims that it is always the case that there are no non-present objects.[70] The eternalist claims that it is always the case that there are some non-

[69] Or put better, at the expense of not analyzing modality.

[70] Markosian, "The 3D/4D Controversy," 3.

present objects.[71] In fact, every object that has existed or will ever exist exists right now. Time is spread out into a manifold with all the different objects and events arranged within it.

Because the eternalist claims that time is extended, he is forced to make a distinction the presentist needs not. The eternalist must claim that for an object to be temporally located at a moment is something beyond that object's merely falling within the domain of our most unrestricted quantifiers at that moment. Making this distinction demands that the eternalist explain what it is about the objects that are temporally located at a moment *t* that differentiates them from those objects that merely exist at that moment. The eternalist must provide an analysis of temporal location.

However, despite the fact that the presentist does not need to distinguish between existence at a time and existence *simpliciter*, the presentist is not spared from the challenge of analyzing location. The presentist accepts that to exist at a particular region of space is not the same as existence *simpliciter*. Thus, the presentist must provide an analysis of spatial location.

On the face of it, there is neither an obvious way of analyzing temporal location nor an obvious way of analyzing spatial location. So both the presentist and the eternalist might agree that spatiotemporal location is primitive and leave it at that. But as we try to do with as few primitives as possible, we should offer an analysis of spatiotemporal location if we are able.

---

[71] Ibid.

Our starting point for an analysis of spatiotemporal location is determining what we mean when we claim that an object is temporally located at a moment. When we say that an object is temporally located at a moment *t*, we claim that there is a subset of all the space-time points that exist *simpliciter* that we call *t* and that some of the space-time points within that subset constitute the object. The question then becomes how we differentiate between the space-time points that are members of the subset *t* and the space-time points that are not.

Differentiating between the points that are members of *t* and the points that are not requires us to appeal to the organizing principle behind the manifold arrangement of space-time points. When we claim that spatiotemporal location is primitive, we take the principle of organization between the space-time points as unexplainable. To analyze spatiotemporal location, we must devise a principle of organization between the space-time points.

We posit causation as the organizing principle behind the arrangement of space-time points. We understand causation as a necessary connection between space-time points. That is, if a point P causes a point Q, then necessarily, P exists iff Q exists, and necessarily, where P and Q exist, P is arranged in a certain way relative to Q. If points P and Q are temporal parts of the same object, then via our conception of causation, we know what it is for P/Q to perdure through time.

Thus, insofar as an object's past temporal parts are causally related to its succeeding temporal parts, then via our conception of causation, we know what it is for a complex object to perdure through time. This principle by which we organize the space-

time points that constitute an object, allows us to chart the worldline of that object. In the same way then, we can chart the worldline of every object.

The issue then lies with connecting the worldlines to the points that do not instantiate objects so that our space-time points have the proper manifold arrangement. We saw, via the general theory of relativity, that the space-time points constituting objects with mass are causally connected to the space-time points that surround them. Thus, there are sufficient causal connections within our world to arrange the space-time points within it into the proper manifold structure.

This shows that causation, as I've characterized it, is a coherent account of the principle of organization between the space-time points within our world. Moreover, objections that my characterization of causation rules out manifestly possible circumstances and that my view is unmotivated by the tenets of Humeanism and genuine modal realism were shown to fail. Thus, we can appeal to my characterization of causation as an analysis of spatiotemporal location.

So far, we've shown that causation can serve as the organizing principle between space-time points. In our proposal, we've assumed the space-time points in our world fit the eternalist's conception of an extended time. Thus, the eternalist can appeal to our proposal in distinguishing those objects that are temporally located at a moment *t* from those objects that merely exist at that moment without expanding his commitment to primitives.

The question now becomes whether the presentist can appeal to a similar causal account in order to analyze spatial location. This issue hinges on what is called the

problem of cross-time relations. It is generally accepted that the *relata* that participate in a relation must both exist. Thus, if presentism demands that the totality of existence is only one space-time point thick, then the presentist cannot appeal to causal relations as a means to organize space.

But even bearing this point in mind, the presentist, on the face of it, may still appeal to something like my causal-relations analysis to analyze spatial location in one of two ways: 1) He could argue that the existence of the *relata* is not a necessary condition on their participating in a relation. Then, he could appeal to tensed causal relations as a way of specifying the organizing principle behind the arrangement of the points. 2) He could accept that the present moment is more than one space-time point thick. Either, the present moment has a thickness of multiple atomic space-time points, or space-time points are gunky. Then, he could appeal to causal relations between these points in order to give the same analysis of spatiotemporal location that we provided the eternalist but on a smaller scale.

Of course, the nuts and bolts of how the presentist would propose to reconcile his view with my analysis of spatiotemporal location would still need to be worked out. While my proposal was primarily designed to appeal to eternalists, there may be refuge in my analysis of spatiotemporal location for the presentist as well. But the details of whether the presentist can appeal to something like my analysis of spatiotemporal location in order to analyze spatial location is a question for another time.

WORKS CITED

Hall, Ned, "Humean Reductionism About Laws of Nature," paper presented to the Arizona Ontology Conference, Tucson, AZ, January 2007.

Lewis, David, *On the Plurality of Worlds* (Oxford: Blackwell, 1986).

Markosian, Ned, "A Defense of Presentism," in *Oxford Studies in Metaphysics*, ed. Dean W. Zimmerman, vol. 1 (Oxford: Oxford University Press, 2004), 47-82.

Markosian, Ned, "The 3D/4D Controversy and Non-present Objects," *Philosophical Papers 23* (1994): 243-249.

Savitt, Steven F., "Presentism and Eternalism in Perspective," paper presented to the Philosophy of Time Society Meeting, Chicago, IL, March 2004.

Schaffer, Jonathan, "The Metaphysics of Causation," <http://plato.stanford.edu/entries/causation-metaphysics/>.

Sider, Theodore, "Four Dimensionalism," *The Philosophical Review 106* (1997): 197-231.

Sider, Theodore, "Presentism and Ontological Commitment," *The Journal of Philosophy 96* (1999): 325-347.

Sider, Theodore, "Temporal Parts," in *Contemporary Debates in Metaphysics*, ed. John Hawthorne et al. (Oxford: Blackwell, Forthcoming).

Van Cleve, James, "Three Versions of the Bundle Theory," *Philosophical Studies 47* (1985), 95-107.

Wudka, Jose, “The General Theory of Relativity,”

<http://phyun5.ucr.edu/~wudka/Physics7/Notes_www/Pdf_downloads/7.pdf>.