

How to Be a Spacetime Substantivalist

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Abstract

The consensus among spacetime substantivalists is to respond to Leibniz's classic shift arguments, and their contemporary incarnation in the form of the hole argument, by pruning the allegedly problematic metaphysical possibilities that generate these arguments. Some substantivalists do so by directly appealing to a modal doctrine akin to anti-haecceitism. Other substantivalists do so by appealing to an underlying hyperintensional doctrine that implies some such modal doctrine. My first aim in this paper is to pose a challenge for all extant forms of this consensus position. My second aim is to show what form substantivalism must take in order to uphold the consensus while addressing this challenge. The result is a novel "plenitudinous" substantivalist view, which predicts that certain modal facts about spacetime are vague or indeterminate. I then argue against this view on independent grounds, concluding that substantivalists should reject the consensus position. The paper also discusses the way forward for substantivalists in light of this conclusion.

Let's start with some background. In contemporary debates about the metaphysics of space and time (or spacetime), a consensus has formed around:

Substantivalism Space and time (or spacetime) exist.

For some purposes this definition would need to be strengthened. The reason is the not uncommon view in metaphysics that most questions about what exists can be trivially answered in the affirmative, and hence we must employ additional ideology (such as fundamentality) to carve out more interesting debates.¹ Proponents of this view will protest that even opponents of substantivalism, called *relationists*, can accept the mere *existence* of space and time (or spacetime); they will just also hold that facts about space and time (or spacetime) are non-fundamental, perhaps adding that these facts somehow obtain wholly

¹For proponents, see Fine (2001) and Schaffer (2009a). For advocates of this view as concerns the debate over substantivalism in particular, see Field (1984) and North (2018).

in virtue of facts about material objects (like tables, chairs, or particles) and their spatiotemporal relations. However, the issues I want to discuss arise for *anyone* who accepts the existence of space and time (or spacetime), irrespective of their views on the further issue of fundamentality. So for our purposes this weak purely existential definition of substantivalism is ideal. If it turns out that just about everyone will accept substantivalism so defined, even self-described ‘relationists’, then all for the best: that would mean just about everyone must wrestle with the issues I will discuss.

You have no-doubt noticed my inclusion of the parenthetical “or spacetime.” The classic debates over space and time presumed the Newtonian idea of an absolute time, which enables us to think of space and time separately, and ask about the spatial facts of the entire universe at any given moment of time. Since the advent of relativity, however, we instead treat space and time together, as a single four-dimensional object called spacetime. I will conduct my discussion in what follows in the setting of our best contemporary physical theory of space and time, namely General Relativity (GR). So henceforth I shall speak of spacetime rather than space and time.² Despite directly discussing only the contemporary debate about the metaphysics of spacetime, it’s worth emphasizing that this debate is very much continuous with, and the contemporary heir of, the traditional debate over space and time familiar from Newton, Leibniz, and Clarke. Moreover, many morals I draw about spacetime can be adapted to the traditional debate about substantial space and time in a Newtonian setting.

Substantivalism is now widely regarded as non-negotiable as concerns the contemporary debate over the metaphysics of spacetime in the setting of GR. I think this is for good reason. I won’t rehash the case for substantivalism here, but let me rehearse some of its components.³ First, GR is a field theory, and substantivalism is presupposed by one very attractive metaphysics of fields, which conceives of fields as properties and relations distributed over spacetime (see Field (1984)).⁴ Second, Newton’s famous bucket argument from the observable effects of non-inertial (accelerated) motion carries over almost unchanged to a relativistic setting. Third, and most importantly, although there are admirable, and arguably empirically adequate, relationist theories in pre-relativistic physics, even proponents of such theories concede the need for at least spatial substantivalism in light of GR, which is substantivalism enough to generate all of the issues I’ll discuss.⁵

²I shall also take on some standard assumptions about spacetime. In particular, I shall write as if spacetime forms a continuum composed of extensionless points. However, those sympathetic to discrete or gunky alternatives—on which there are no spacetime points but only extended regions—will be able to adapt everything I say to their preferred setting.

³For a classic survey of the large literature on the debate between substantivalism and relationism, see Earman (1989).

⁴Moreover, see Arntzenius (2012, ch.5) for arguments that alternative metaphysics of fields (according to which they are objects) render relationism equally as vulnerable as substantivalism to the kinds of shift arguments I’ll be discussing.

⁵See especially Julian Barbour’s work; for instance, the popular overview in Barbour (1999). For a detailed investigation of Barbour’s program, see Arntzenius (2012, ch.1), which brings out the concession to substantivalism in light of GR at pp.36-38 and p.173.

At centre-stage in the bulk of work on spacetime over the past few decades has not been substantivalism, which is usually taken as given, but instead a widely-held modal desideratum. In particular, the consensus in the area is that we should strive to eliminate certain metaphysical possibilities that seem to be forced upon us once we embrace substantivalism: roughly, metaphysical possibilities that differ merely over which spacetime points have which field values. Some take this modal desideratum to be non-fundamental, and claim that its truth must be explained in terms of some underlying hyperintensional doctrine. But they still maintain the truth of the desideratum all the same, which suffices for them to fall under the purview of my discussion. I will spell out this standard modal desideratum in detail in the next section. For now, it is hard to overemphasize how much it has driven the extant debate over the metaphysics of spacetime.⁶

My first goal in what follows is to undermine all forms of this consensus position in the metaphysics of spacetime (the combination of substantivalism with the standard modal desideratum). I'll raise a problem for all extant views that imply the standard modal desideratum, which I call the problem of *modal arbitrariness*. I'll then argue that every means of avoiding this problem either faces another problem, which I call the problem of *cheap determinism*, or else is objectionable on independent grounds.

My goals here also go beyond arguing that the consensus position in the metaphysics of spacetime is untenable. In particular, my own view is that the crucial commitments of the consensus position have yet to be appreciated. As a result, the task of examining how proponents of the consensus might respond to my modal arbitrariness challenge will be quite involved, and take us in some unfamiliar directions. For instance, we'll see that amongst the best responses to the arbitrariness challenge is to claim that certain modal facts about spacetime are *vague*. We'll then consider different options for implementing a vagueness-theoretic response, ultimately being lead to develop a novel substantivalist metaphysic of spacetime that does so, which I call *plenitudinous substantivalism*. This doctrine is of independent interest for those hoping to rescue the consensus position, and also offers a precise and intelligible doctrine that vindicates certain deflationary impulses in the extant literature. Still, in the end I take the doctrine to fall foul of my cheap determinism challenge, which is why I conclude that that the widespread modal desideratum is in fact *not* something we should strive to secure, contrary to the standard wisdom amongst philosophers working on spacetime. However, perhaps more important than the particular conclusion I reach, we'll see that the modal arbitrariness challenge offers a better understanding of what the important choice-points in the metaphysics of spacetime are, and how the dialectical landscape should be conceptualized moving forward.

⁶Pooley (2006, 101) describes the desideratum as "close to a consensus" in the literature. I will list some of the desideratum's many proponents in footnote 14 below, after stating it.

1 The Modal Desideratum

The classic allegedly problematic metaphysical possibilities for substantivalists were those used by Leibniz to argue against Newtonian substantival space. (Henceforth I will generally drop the qualifier ‘metaphysical’ when speaking of metaphysical possibility and metaphysical necessity; my unqualified uses of modal vocabulary throughout should be understood as expressing metaphysical modality.) For instance, Leibniz pointed out that, assuming substantival space, we seem to be saddled with a continuum of possibilities corresponding to every way of shifting all matter over some fixed duration in time, or some fixed distance in some fixed direction in space, but leaving everything else unchanged (including what the laws of nature are).⁷ The contemporary incarnation of the position shift in GR (or any other field theory) is that, assuming substantival spacetime, we seem to be saddled with a continuum of possibilities corresponding to every way of smoothly and uniformly redistributing all fields over spacetime at some possibility but leaving everything else unchanged.⁸

Because we are directly discussing only the contemporary debate, we will focus on the latter supposedly problematic plethora of alleged metaphysical possibilities. Let me describe them more slowly. You can think of a field (including the metric field, which encodes facts about distances) as a property or relation distributed over spacetime. GR is a field theory, and we will adopt the simplifying assumption that the only objects at metaphysical possibilities where GR is true are spacetime points; on this picture, what we traditionally think of as material objects (like particles) at such possibilities are instead certain patterns of instantiation of certain fields, called matter fields.⁹ The laws of GR impose only constraints between the behavior of spacetime (as described by the metric field) and the behavior of matter (as described by the matter fields) at each arbitrarily small patch of spacetime.¹⁰ This amounts to constraints on the *pattern* or *distribution* of

⁷Of course, the other classic “Leibniz shift” was a uniform velocity boost of all matter, which I shall ignore in the main text. Note that the standard response to velocity boosts—namely, embracing a neo-Newtonian spacetime, which lacks a standard of absolute velocity—still leaves the alleged worry stemming from position shifts unchanged. For clear summaries of this dialectic, see Sklar (1974), Maudlin (2012), and Dasgupta (2015b).

⁸More carefully, let S be a mathematical solution that we’re using to model some possibility where GR is true. Then the alleged continuum of possibilities would comprise those we would standardly model mathematically using those solutions that result from transforming all tensor fields in S under the action of some diffeomorphism from the manifold of S to some (possibly identical) manifold (assuming some such diffeomorphism exists), where a diffeomorphism is a smooth (C^∞) bijection with a smooth inverse. See Wald (1984, 437-438) for the formal details, including how different tensor fields transform under the action of diffeomorphisms. I should flag that the standard focus on diffeomorphisms is somewhat misleading: for many purposes to which diffeomorphisms are put (especially in discussions of the hole argument) the more general class of arbitrary permutations, smooth or not, would serve equally well (see Maudlin (1988, 84-85) and Melia (1999, 642-643)). Nevertheless, I will focus on diffeomorphisms, which simplifies my discussion at various points and keeps it more in line with the existing literature.

⁹This is to take GR to vindicate the doctrine of *supersubstantivalism*. For discussion and defense, see Schaffer (2009b). Everything I say throughout the main text could be rephrased more clumsily without this assumption about GR.

¹⁰More carefully, the constraints are between the Einstein tensor and the stress-energy tensor. The former is

certain properties and relations across spacetime. But crucially, these constraints can be satisfied irrespective of *which particular* spacetime points play which roles in this pattern. As a result, if we were to smoothly and uniformly redistribute *all* fields over spacetime at some metaphysical possibility where the laws of GR are true, the resulting metaphysical possibility (if such there be) would still be one where the laws of GR are true, because the *pattern* of instantiation by spacetime of the properties and relations corresponding to the metric and matter fields would be left unchanged. The same would be true if we do not redistribute the pattern over whatever spacetime points there are at the original possibility w , but instead preserve the pattern and consider alleged possibilities where it is realized in part by some spacetime points numerically distinct from any spacetime points at w .¹¹

Let us write throughout as if the true final laws of our world are simply those of GR, and thus henceforth call metaphysical possibilities where the laws of GR are true *nomic possibilities*. Now, call nomic possibilities that differ *only* over a smooth and uniform redistribution of all fields *shift-related*. (Clarifications: (i) we understand redistributions to allow for new spacetime points, and (ii) shifts must be non-trivial, hence no possibility is shift-related to itself.) Then the standard modal desideratum amongst substantivalists is:

No-Shifts There are no shift-related nomic possibilities.

The focus in the debate has often been on a stronger modal doctrine called anti-haecceitism, which implies no-shifts. To introduce this doctrine, we first need some definitions. *Qualitative propositions* are those propositions not about any particular objects; all other propositions are *haecceitistic* or *non-qualitative*. For example, the proposition that some spacetime point or other has such-and-such field value is qualitative; whereas the proposition that spacetime point o has such-and-such field value is haecceitistic (because it is about o). We can now state the following modal doctrine:

Anti-Haecceitism No metaphysical possibilities differ without differing over the truth value of some qualitative proposition.¹²

Anti-haecceitism rules out metaphysical possibilities that differ *only* over the truth value of haecceitistic propositions. Now notice that shift-related possibilities, as we defined them,

definable from the metric field (assuming we're working with the standard Levi-Civita connection, which is definable from the metric field). The latter is definable from the metric field and whatever matter fields there are. These details don't bear on the issues I'm discussing, so I'll gloss over them throughout.

¹¹See my "revised hole argument" in Teitel (2019b, 369-71) for why this generalization of the standard method for generating new alleged possibilities to encompass merely possible spacetime points is important.

¹²Numerous distinct doctrines have gone under the heading of 'anti-haecceitism' over the past several decades. Indeed we will be discussing some of these alternative doctrines below. Here I am picking up on one prominent usage, according to which anti-haecceitism is a straightforward modal doctrine, not a doctrine about what is fundamental, or how we use certain mathematical formalisms to model modality, or the metaphysics of possible worlds, or about which modal facts are somehow defective (though it may have implications for such doctrines). For further discussion, see Skow (2008), Dasgupta (2011), Russell (2014, 2015), Teitel (2019a,b), sections 2 and 6 below, as well as footnote 34 below.

are exactly of this sort. A smooth and uniform redistribution of all fields amounts to changing only haecceitistic facts concerning which particular spacetime points instantiate certain properties and relations, but leaving everything qualitative unchanged (in particular leaving unchanged all qualitative propositions detailing the pattern of instantiation of all fields by some spacetime points or other). We see then that anti-haecceitism implies no-shifts.¹³

As mentioned near the outset, anti-haecceitism and no-shifts have shaped much of the extant debate about spacetime, and are widely adopted.¹⁴ Why is this so? Again, I'm ultimately going to argue against these standard modal desiderata. Still, let me give you some common reasons that are supposed to support no-shifts. The traditional Leibnizian motivations—from the Principle of Sufficient Reason and the Principle of the Identity of Indiscernibles—are nowadays just about universally rejected. Instead, two alternative motivations are most commonly given.

The first is based on general theoretical virtues. Shift-related possibilities would seem to saddle us with a continuum of distinct but empirically equivalent possibilities.¹⁵ And either a norm against empirically undetectable facts, or some norm in favor of simpler theories, each might dictate preferring an alternative account of what the world is like that does not leave us with such possibilities if some such account is available.

The second common motivation stems from considerations about determinism. This motivation moves me considerably more than the previous one, given how slippery questions about what makes for simplicity and the epistemic force of non-empirical virtues can be. Indeed I take considerations of determinism to offer the best hope of defend-

¹³Various transformations are often lumped together with translations and redistributions of fields under the heading of 'symmetries', such as velocity boosts. Notice that these change qualitative in addition to haecceitistic facts, and hence raise quite separate issues. In particular, the status of such transformations is left untouched by anti-haecceitism, though other methods are available to eliminate putatively surplus, yet qualitatively discernible, possibilities (see also footnote 7).

¹⁴Again, Pooley (2006, 101) describes the doctrines as "close to a consensus" in the literature. For just a sampling of proponents of anti-haecceitism or no-shifts (which nevertheless sometimes hold views that are altogether different in other respects), see Field (1984), Butterfield (1989), Maidens (1992), Brighouse (1994), Hofer (1996), Pooley (2006), Dasgupta (2011), and Teitel (2019b). Maudlin (1988, 1990) defends an essentialist doctrine, also with the aim of securing no-shifts, though its modal implications are in fact somewhat weaker, and don't rule out all shift-related possibilities (see Teitel (2019b, 369-73)). One fraught piece of terminology worth mentioning here is 'sophisticated substantivalism', which is often used to describe the combination of substantivalism with either anti-haecceitism or no-shifts (in accordance with how it was first introduced by Belot & Earman (2001, 227-28)). However, the terminology is also used to describe numerous other distinct doctrines: those concerning mathematical models of the sort I'll discuss in the next section, or more radical doctrines of the sort I discuss in section 6 that are meant to somehow deflate the very notion of haecceitistic modal facts about spacetime (see, for example, Baker (2010, 1161)). The label 'spacetime structuralism' is used in all of these senses and more besides, though many structuralists (often champions of the more general doctrine of "ontic structural realism") also want to take on something in the vicinity of anti-haecceitism and no-shifts. (See Ladyman (2014) for an overview, and Dorr (2010), Greaves (2011), and Sider (2020) to get a sense of the numerous inequivalent doctrines that are often lumped together in discussions of structuralism.) So as not to confuse matters further, I won't use either of these labels. Russell (2014, 2015) defends a related view where only qualitative propositions are "factual," and thereby champions anti-haecceitism for what's "factual". I'll discuss Russell's views in section 6.

¹⁵See Roberts (2008) and Dasgupta (2009, 2011) for why. Maudlin (1993, 2012) argues that we can know which such possibility we're in nevertheless using indexical resources; Dasgupta (2015a) advocates the dissenting view.

ing anti-haecceitism or no-shifts, and hence this motivation will be our focus in what follows. The motivation is arguably peculiar to field theories like GR. Notice that one way to smoothly and uniformly redistribute all fields leaves everything unchanged at some times, but smoothly and uniformly redistributes all fields at other times.¹⁶ The possibilities that result seem to be a straightforward counterexample to GR's determinism, understood as precluding nomic possibilities that agree on all propositions at one time but differ on some proposition at some other time. For the resulting nomic possibilities agree on all propositions at some time but differ at some other time over (and only over) certain haecceitistic propositions about which particular spacetime points have which field values. This construction is the famous "hole argument," first sketched by Einstein, but resurrected and put in its canonical form by Earman & Norton (1987). Since then the hole argument has been at centre-stage in debates over the metaphysics of spacetime, along with the desideratum of no-shifts.¹⁷ There is a large debate about how precisely to state the argument, including why we should be invested in rescuing GR's determinism, and also the appropriate reaction to the argument (see footnote 17). For now, the important point is that the argument is widely taken to support no-shifts.¹⁸

Again, the plan is to raise a problem for all extant views that imply anti-haecceitism or no-shifts, and then to show that every attempt to rescue these views from the problem requires embracing doctrines that only lead to other problems. I will turn to that task in section 3. Before getting there, I want to first consider and reject one prominent attempt to secure the benefits of no-shifts via an alternative doctrine that does not concern modality. Seeing the failure of this attempt will justify our needing to directly engage with the modal doctrine of no-shifts itself. I will also consider a few other attempts to indirectly secure the benefits of no-shifts in section 6, when I compare the plenitudinous substantialist metaphysic with extant alternatives.

¹⁶I take "times" to be regions of spacetime that play the role of simultaneity surfaces. At general relativistic possibilities these are Cauchy surfaces; hence, we are focusing on a certain sector of GR, called the globally hyperbolic sector (which contains only those nomic possibilities that contain a Cauchy surface). This restriction is widely adopted in discussions of GR's determinism, and is universally adopted in the literature on the hole argument (the argument being presented in this paragraph). The restriction isn't strictly speaking necessary, however: determinism (which we'll define in section 7) is simply vacuously true of those nomic possibilities with no times. Finally, note that of course the foliation of any nomic possibility that admits a Cauchy surface into Cauchy surfaces is *highly* non-unique (for reasons exactly akin to why we have the familiar "relativity of simultaneity" in even the Minkowski spacetime of Special Relativity).

¹⁷The argument is so-named because the region where the fields are redistributed is standardly called the "hole" (the argument has nothing to do with holes in the familiar sense). For an overview of the hole argument and the sea of replies it has provoked, see Norton (2015).

¹⁸It is worth flagging that no-shifts (and hence anti-haecceitism) is strictly stronger than what's required for those concerned only to rescue GR's determinism: only shifts that leave everything unchanged at some time need be eliminated to rescue determinism (see footnote 33 of Teitel (2019b)).

2 The Mathematical Route: Gauge

For those familiar with the literature on spacetime, our discussion so far may have seemed unusual. The reason is that the discussion is often not conducted directly in modal terms, as ours has been, concerning what's metaphysically possible holding fixed the laws of GR. Instead, the usual procedure is to start by discussing features of the *solution space* of a general relativistic theory, where a solution space is a purely mathematical object (a class of mathematical models) that we use to represent the space of nomic possibilities. Most discussions will then focus on questions about how we use this solution space to model the modal facts. For example, if you take a cursory glance at just about any of the literature on the hole argument, you will find the primary focus on questions like whether we use diffeomorphically related solutions to model the same or distinct nomic possibilities. You can think of diffeomorphically related solutions as the mathematical analogues of the shift-related nomic possibilities we described above, which differed only over a smooth and uniform redistribution of all fields (see footnote 8 for a more careful gloss).

This standard methodology then percolates up into how the desideratum of no-shifts (and even anti-haecceitism) is understood. For many take our two constraints above to be vindicated by supplementing substantivalism with some doctrine about how we use solutions to model nomic possibilities; for instance, the doctrine that if we use some solution s of a general relativistic theory to model some nomic possibility w , then we must also use any solution diffeomorphically related to s to model w . The usual terminology wheeled in here is that of gauge-freedom. The word 'gauge' is used in numerous ways, but the sense that concerns us is the following: some difference between the solutions (again, these are purely mathematical objects) of some physical theory is merely gauge just in case the difference is not used to model a non-mathematical difference between nomic possibilities. So mere gauge differences are those we take to be artifacts of our mathematical formalism, rather than mathematical differences we use to represent genuinely different ways the non-mathematical world itself could have been.¹⁹ In this terminology, the supposed mathematical route to implementing no-shifts is:

No-Mathematical-Shifts Differences between diffeomorphically related solutions are mere gauge.

No-mathematical-shifts—a doctrine concerning how we use the formalism of GR to describe the non-mathematical world—is widely held amongst both physicists and philosophers.²⁰ The doctrine even appears in what is arguably the authoritative text on GR: “diffeomorphisms comprise the gauge freedom of any theory formulated in terms of tensor

¹⁹Of course we can in principle use any mathematical objects to represent just about anything whatsoever. So claims about which transformations are or are not mere gauge must be understood against the background of some representational conventions. For further discussion of this point, see Teitel (2021, section 2).

²⁰For instance, most of the works cited in footnote 14 as proponents of no-shifts also adopt the corresponding doctrine about mathematical solutions (indeed often moving freely between the two distinct doctrines).

fields on a spacetime manifold. In particular, diffeomorphisms comprise the gauge freedom of general relativity” Wald (1984, 438).²¹

The problem is that no-mathematical-shifts simply does not speak to the truth or falsity of the doctrine we are interested in, namely no-shifts itself. (And nor does no-mathematical-shifts speak to the truth or falsity of the stronger doctrine of anti-haecceitism.) No-shifts is a modal doctrine, concerning the space of metaphysical possibilities where the laws of GR are true. By contrast, no-mathematical-shifts is a doctrine about how we use a particular mathematical formalism. And it is just a mistake to think that the mathematical doctrine implies the modal one. To see this, notice that there is nothing incoherent about a substantialist who accepts no-mathematical-shifts yet rejects no-shifts. To do so, she need only adopt representational conventions governing how to use the formalism of GR that predict no-mathematical-shifts, and there are many options for doing so. For instance, perhaps she thinks that, although there are shift-related nomic possibilities, for every equivalence class of diffeomorphically related mathematical solutions we use each member of the equivalence class to represent the *same* qualitative proposition (thereby rendering differences between the solutions in the equivalence class mere gauge), namely the qualitative proposition which is true at all and only the members of the corresponding equivalence class of shift-related nomic possibilities. These representational conventions may not be our own, but their coherence is all we need to bring out the conceptual rift between no-mathematical-shifts and the target desideratum of no-shifts itself.

Moreover, given the motivations for no-shifts, we know the modal doctrine is what must be at issue. Hence, the proponent of no-mathematical-shifts cannot reply that we should simply replace the desideratum of no-shifts with the distinct doctrine of no-mathematical-shifts. To see this, we need only recall the supposed motivations for trying to vindicate no-shifts in the first place. If sound, these motivations support trying to prune the space of nomic possibilities, but are simply silent on the question of how we choose to represent these possibilities using a solution space. For example, notice that determinism is a modal thesis: remember that a counterexample to GR’s determinism requires nomic possibilities that agree on all propositions at a time but differ over some proposition at some other time.²² Thus what matters for GR’s indeterminism is simply whether *there are* shift-related nomic possibilities. If there are then GR is indeterministic; end of story. What else we say

²¹Belot (2018, 960, 975) memorably describes this slogan as “scripture” from “The Gospel According to Bob.”

Elsewhere Wald describes all diffeomorphically related solutions as “representing the same physical solution” (1984, 260). Again, similar remarks abound throughout the philosophical literature (including most of the works cited in footnote 14), and various other textbooks on GR (see, for example, Sachs & Wu (1977, 27)).

²²See Teitel (2019b) for a more careful definition, which I’ll present in section 7 below. Modal definitions of determinism of this sort have been the standard in the literature at least since Lewis (1983) and Earman (1986a). Modal definitions are also needed to make sense of standard debates about the implications of determinism. For example, the large debate about the compatibility of our ability to do otherwise and determinism gets going precisely because the modal implications of determinism seem to preclude the possibility of our acting other than we in fact act without either the laws of nature being different or the state of the universe at some time in the past being different.

about how we use the formalism of GR to describe these nomic possibilities is neither here nor there.

Of course there may be an argument in the other direction, from no-shifts to no-mathematical-shifts. For example, perhaps if no-shifts is true then any reasonable representational conventions will vindicate no-mathematical-shifts: if there are no shift-related nomic possibilities, then arguably there are no distinct nomic possibilities one could sensibly model with diffeomorphically related solutions, and hence such solutions should be taken to be merely gauge different. Still, I think at best this reveals doctrines about the solution space of GR to be a quite indirect route towards arriving at the modal subject matter of interest, and no substitute for simply discussing the modal questions at issue directly. Moreover, the important points above remain: the two sorts of doctrines are just about different topics, and it is simply a mistake to think that one can infer no-shifts from no-mathematical-shifts.²³

It is also worth stressing how little no-mathematical-shifts tells us. We have seen that the doctrine does not imply no-shifts. Moreover, the doctrine tells us just about nothing about what possibilities where GR is true are like. Suppose no-mathematical-shifts were true: we now know that we use each member of any equivalence class of diffeomorphically related solutions to model the same nomic possibilities. Yet that is all we have learned, and so this doctrine just raises a host of further questions: which nomic possibilities do they represent? And what are those possibilities like? We are now seeing some general limitations of this standard methodology of getting at whatever non-mathematical subject matter is at issue only indirectly, via the mathematics of our best physical theories. In general, proponents of any of the different options in many debates in the metaphysics of physics can *agree* on questions concerning mathematical representation, including which differences are mere gauge. Thus, being told that such-and-such difference is mere gauge does not even begin to qualify as an answer to metaphysical questions like what GR is telling us about the world, but rather leaves these central non-mathematical questions at issue untouched. At best, determining which differences are gauge is a preliminary step towards developing an adequate answer to the non-mathematical questions we're generally interested in.²⁴

We see then that the very idea of a mathematical substitute for no-shifts is a myth. Mathematical doctrines like no-mathematical-shifts, despite their prominence in extant discussions, simply fail to make contact with the questions about the metaphysics of space-time and modality at issue. They thus do not offer a way around engaging with the ques-

²³The point in the preceding three paragraphs was a central theme throughout Teitel (2019a) and Teitel (2021). For further discussion and defense, see those papers as well as Teitel (2019b, 388-89). In all of this I am very much in agreement with how Dasgupta (2011) sets up the issues, who forcefully drives home how questions about mathematical solutions are largely irrelevant to the debate.

²⁴For further discussion and defense of the claims in this paragraph, see Teitel (2021). Compare also Earman (1986b, 236-37), where he describes the process of declaring some equivalence class of solutions merely gauge different as "easy words," and disparagingly contrasts proposing an actual metaphysic with the less impressive feat of "drawing circles around groups of space-time models and labeling them equivalence classes."

tions that are occupying us here.

3 From Anti-Haecceitism to Modal Arbitrariness

Returning to the main thread, I will now raise a problem for any view that predicts no-shifts. I call it the problem of *modal arbitrariness*. I'll focus on standard views that predict no-shifts via the stronger doctrine of anti-haecceitism, though the problem also arises for no-shifts itself.

Notice what anti-haecceitism implies: every maximal way things could have turned out qualitatively has a *unique* non-qualitative realization. Similarly for no-shifts: once you fix the complete qualitative facts about how all fields are distributed across spacetime at some nomic possibility, the doctrine requires that qualitative pattern to have a *unique* non-qualitative realization. Now the problem is that it is hard to fathom what could privilege one such non-qualitative realization over any other. For example, suppose we are at some nomic possibility where I'm sitting (where, again, we're taking nomic possibilities to just be metaphysical possibilities where the laws of GR are true). We now imagine what things would be like if reality had differed qualitatively somewhat; for instance, if everyone sitting now had been standing instead, but otherwise we depart minimally from the qualitative way things are. Given no-shifts, and hence also anti-haecceitism, there is only one way this qualitative pattern would have been realized. Yet any way of saying how this qualitative pattern gets realized would seem to be wholly arbitrary. For instance, suppose the tip of my nose (which we're supposing to be some pattern in the matter fields there are) is in fact located at spacetime point o . In the everyone-standing possibility, is the tip of my nose still at o , or is my bellybutton now located at o ? Notice that, given no-shifts or anti-haecceitism, opting for one option renders the other *impossible*. Yet what could privilege one of these options over the other? And an analogous question arises for everyone that changes from sitting to standing across the two possibilities.

Perhaps in cases like the example above, where we consider reasonably small qualitative differences, there's some hope of giving a principled answer to these awkward haecceitistic modal questions. But of course the same issue will arise ad nauseam, encompassing also cases of possibilities that are altogether qualitatively different. And here the charge of arbitrariness becomes even more severe. For example, suppose we start at the same nomic possibility as before, but now consider a nomic possibility which contains just an eternal black hole of some specified mass. We now ask whether spacetime point o (which, recall, is where the tip of my nose is located), would be outside the event horizon of the black hole at this alternative nomic possibility. Again, given no-shifts, and hence also anti-haecceitism, opting for one answer to this question renders every other answer *impossible*. Yet it seems completely mysterious what might privilege one answer to this question over any other.

Generalizing from these examples, anti-haecceitists and proponents of no-shifts are committed to a huge range of seemingly brute non-qualitative modal facts, about how each possible complete qualitative pattern gets uniquely realized across modal space. By contrast, notice that those who reject these doctrines face no such challenge: they think that each complete qualitative pattern can have countless non-qualitative realizations, and hence have no need to privilege one such realization over the others. For instance, just focusing on nomic possibility, haecceitists can hold that any spacetime points could have played any qualitative roles, and hence, for any way of distributing some complete qualitative pattern of field values over some spacetime, there is a nomic possibility where those field values are realized in that way.²⁵

One non-arbitrary way to answer these awkward questions, at least as concerns spacetime points, is to maintain that spacetime points have extremely demanding modal essences, and in particular that they admit of *no* modal variation.²⁶ More precisely, this answer maintains:

Demanding-Modal-Essences Necessarily, for every spacetime point *o*, necessarily if *o* exists then *o* stands in the spatiotemporal relations it in fact stands in *to the particular spacetime points it in fact stands in those relations to*.²⁷

This amounts to an extremely strong qualitative and non-qualitative necessary modal constraint on the existence of any spacetime point, which renders it world-bound at nomic possibilities given our other assumptions about GR.²⁸ Supplementing no-shifts with demanding-modal-essences avoids the problem of modal arbitrariness: the resulting package predicts that any distinct maximal qualitative ways spacetime could be are realized by *disjoint* classes of spacetime points. As a result, we do not face the seemingly intractable task of saying in a principled way which spacetime points at any given nomic possibility would still be around for each other maximal way things could have been qualitatively (the answer always turn out to be ‘none!’), and hence neither must we provide a principled answer as to which geometric roles each of those points would have played for each other maximal way things could have been qualitatively. Supplementing anti-haecceitism with

²⁵I first stated the modal arbitrariness problem in passing in footnote 13 of Teitel (2019b), and blithely suggested in footnote 52 that anti-haecceitists reply by appealing to vagueness. We shall see that making good on this suggestion is highly non-trivial, and I now think that, alas, it ultimately cannot be done.

²⁶Throughout, I understand spacetime regions to be mereological fusions of spacetime points. Hence, every doctrine concerning points in the main text implies a corresponding doctrine for spacetime regions.

²⁷Here and throughout I write as if existence can be a contingent matter. Some deny this, and follow Williamson (2013) in embracing *necessitism*, the doctrine that necessarily everything necessarily exists. Necessitists should interpret my talk of ‘existence’ throughout in terms of some property they think can hold contingently, for instance interpreting my qualifier ‘if *o* exists’ here to express the same thing as something like ‘if *o* is a spacetime point’.

²⁸Roughly, this is because once we assume that there are no material objects at nomic possibilities (as we did in section 1), and instead only matter fields, then the Einstein equation implies that the properties of matter globally supervene with nomic necessity on properties of spacetime. Recall footnote 10, however, on the qualifications needed here. For further discussion, see Teitel (2019a, 50-52).

demanding-modal-essences of course also solves the arbitrariness problem at nomic possibilities, given that anti-haecceitism implies no-shifts. An additional analogous modal doctrine for material objects would be needed for metaphysical possibilities with objects besides spacetime points, though here we shall continue to focus on possibilities, like our nomic possibilities, where the only objects are spacetime points.

The issue is that demanding-modal-essences is vulnerable to a difficulty that I call the problem of *cheap determinism*.²⁹ Indeed, I'll argue in the rest of the paper that every doctrine proponents of anti-haecceitism or no-shifts might appeal to in order to avoid the modal arbitrariness challenge either faces the problem of cheap determinism or else is problematic on independent grounds. I will wait until we have the other relevant doctrines on the table before stating the cheap determinism problem in detail and considering various attempts to reply to it (section 7). The reason is that the dialectic surrounding these replies is similar for demanding-modal-essences and the other relevant doctrines, so it will prove expedient to discuss them together. But let me here sketch the problem as it arises for demanding-modal-essences.

Remember from section 1 that arguably the central and most promising motivation for no-shifts is to avoid the pervasive failures of determinism that substantivalists seem to be stuck with otherwise, brought out by the hole argument. There is much to say about whether and why these failures are problematic, but a common way to voice the concern is that the failures are somehow too cheap or trivial to conjure up.³⁰ And the problem of cheap determinism is that demanding-modal-essences makes the *vindication* of GR's determinism equally cheap, by rendering spacetime-centric haecceitistic threats to determinism, like those at issue in the hole argument, *metaphysically impossible*. Remember that some laws are deterministic just in case no possibilities where those laws are true that agree on all propositions at some time differ on some proposition at some other time (we'll look at a more careful formulation in section 7). Yet given demanding-modal-essences, any spatiotemporal difference, however minuscule, across any metaphysical possibilities whatsoever engenders a total change in which spacetime points there are. As a result, all such possibilities at *no* time agree on all propositions, because they all differ at each time over some propositions about which particular spacetime points there are.³¹ Demanding-

²⁹I've argued against demanding-modal-essences in previous work, including the present challenge from cheap determinism (see Teitel (2019b, 373-79)). More precisely, there I argued against the essentialist analogue of this modal doctrine (which I labeled *non-qualitative metric essentialism*). However, I explicitly noted that my two central arguments, including the cheap determinism problem, targeted only the modal implications of non-qualitative metric essentialism, which is exactly the modal doctrine of demanding-modal-essences. The cheap determinism challenge to demanding-modal-essences was first pointed out to me by Cian Dorr (see also Belot (2018, footnote 51)).

³⁰In Earman and Norton's own words, "a metaphysic which automatically decides in favour of indeterminism is [...] unacceptable. Determinism may fail, but if it fails it should fail for a reason of physics" (1987, 524) (see also Earman (1989, 180-181)). In Teitel (2019b, 356-57) I argued against the force of this motivation, but suggested an alternative motivation for rescuing GR's determinism stemming from a non-Humean account of laws of nature.

³¹You might wonder whether we can avoid the problem by finessing what it means for possibilities to agree

modal-essences thus gives us determinism on the cheap: without possibilities that agree on all propositions at some time, necessarily a threat to determinism can't get off of the ground, even in cases of laws that (unlike GR's) might seem to be paradigms of indeterminism in the spatiotemporal facts.

Yet once we reject demanding-modal-essences, we allow for *some* modal variation; that is, we allow that some spacetime points can exist at multiple possibilities. And once this door is open, anti-haecceitists are immediately saddled with my challenge from modal arbitrariness: they need to provide *unique* answers to which geometric roles each spacetime point plays across possibilities, and there does not seem to be any principled way to provide such answers. More generally, provided we also reject the analogue of demanding-modal-essences in terms of nomic necessity, we allow that some spacetime points can exist at multiple nomic possibilities. As a result, all proponents of no-shifts would then immediately face my challenge from modal arbitrariness.

I should emphasize again that the modal arbitrariness challenge arises for every view that implies anti-haecceitism or no-shifts, irrespective of what the view says about the fundamentality of modal facts or haecceitistic facts. Thus even views according to which modal doctrines like anti-haecceitism are highly non-fundamental facts face exactly the same challenge: if there are facts about the modal profiles of particular objects, and those objects do not have super demanding modal essences, then given anti-haecceitism or no-shifts such facts would seem to be inevitably arbitrary. The challenge thus arises for views that follow Fine (1994) in holding that modal doctrines like anti-haecceitism obtain in virtue of underlying essentialist doctrines (in this case the doctrine of sufficiency metric essentialism that I developed in Teitel (2019b)). Similarly, the challenge arises for views where all haecceitistic facts obtain wholly in virtue of qualitative facts (sometimes called grounding qualitativism or generalism), which nevertheless maintain that *there are* the relevant non-fundamental haecceitistic facts, and moreover are meant to imply anti-haecceitism.³² Again, the modal arbitrariness arises irrespective of whether the modal or haecceitistic facts at issue are non-fundamental.

We see then that proponents of no-shifts (and hence anti-haecceitists) seem to face a dilemma: super demanding modal essences or wholly arbitrary modal essences. The first horn falters on the objection of cheap determinism, and so we must now investigate whether proponents of no-shifts can champion the second horn, and try to temper the sting of arbitrariness.

How might proponents of no-shifts or anti-haecceitism try to champion the second horn of our dilemma, in spite of the modal arbitrariness challenge? Where arbitrariness threatens, the natural reply is to appeal to *vagueness* or *indeterminacy* (I will use these terms

on all propositions "at some time." I will discuss this issue at length in section 7, when considering replies to the cheap determinism challenge.

³²For sympathetic discussion of views of this sort, see Van Cleve (1985) and especially Dasgupta (2009, 2011, 2017). For critical discussion, see Turner (2017) and Sider (2020, ch.3).

interchangeably). The abstract structure of the vagueness-theoretic reply to some arbitrariness challenge goes as follows: although determinately one of the many seemingly arbitrary choices obtains, no single choice determinately obtains, rather it's indeterminate which obtains. As applied to our particular setting, proponents of no-shifts might say that determinately each maximal qualitative way spacetime could be has a unique non-qualitative realization, yet there is no determinate answer to the seemingly intractable questions about (i) whether any given spacetime point would still exist across different nomic possibilities, and (ii) which geometric roles it would play across different nomic possibilities if it did exist. Proponents of no-shifts or anti-haecceitism thus seem to be pushed towards some view where there is vagueness or indeterminacy in propositions about the modal profiles of particular spacetime points (and hence particular spacetime regions).³³

Once they get pushed towards some view where there is indeterminacy in the relevant haecceitistic modal propositions about spacetime, the immediate follow-up question is: what's the source of this indeterminacy? The most well-developed option here is to blame the modal operators, and claim that metaphysical modality can be a distinctive source of vagueness when applied to haecceitistic propositions. This is exactly the kind of view exemplified by Lewis' counterpart theory. I will argue in the next section that this first option is independently problematic. That will then force us to claim that the vagueness of modal propositions about particular spacetime points stems from the notion of a spacetime point or region itself. Following through on this second option will lead us to develop the novel metaphysics of plenitudinous substantivalism, alluded to at the outset.

4 Against Distinctively Modal Indeterminacy

The exemplar of a view that sources the vagueness of the relevant seemingly arbitrary haecceitistic modal propositions about spacetime in metaphysical modality itself is Lewis' counterpart theory (see especially Lewis (1986, ch4)). On this view, when we ask haecceitistic modal questions, we must invoke some contextually salient "counterpart relation,"—think of this as a means of settling every object's modal profile—and it might be vague which such relation is at issue. For example, suppose we ask 'Is it metaphysically possible for me to have been a fried egg?'. For the counterpart theorist, there are numerous admissible interpretations of 'metaphysically possible' that might be invoked here: possibility according to this counterpart relation, possibility according to that counterpart relation, and so on. These countless operators will agree on all qualitative propositions, but

³³There are of course large debates about the nature of vagueness itself. For a classic overview, see Williamson (1994). For a more recent overview, see Bacon (2018, chs.1-2). However, we can largely remain neutral on such debates. The main substantive assumption I'll make is that vagueness does not call for a revision of classical logic (for defense, see Bacon (2018, 6-10)). Also, I'm sympathetic to treating vagueness as a predicate of sentences, rather than an operator on propositions. However, to ease exposition I'll often employ the operator-theoretic regimentation, though everything I say can be adapted to either setting.

might disagree over the haecceitistic modal facts: perhaps ‘it’s possible that I am a fried egg’ is true when our modal talk is interpreted in terms of some such operators, whereas ‘I am necessarily human if I exist’ is true when our modal talk is interpreted in terms of others. Which such flavor of modality is at issue in some context is a matter of the usual messy mechanisms of context-sensitivity, and in many contexts it will be vague which such operator is invoked. In such contexts, the haecceitistic modal question ‘Is it metaphysically possible that I am a fried egg?’ may itself be vague, where notice that on this view it is the notion of metaphysical modality itself that is the source of this vagueness.

Proponents of no-shifts can apply Lewis’ view to try to address the problem of modal arbitrariness.³⁴ In particular, they can say that although, in every context, all admissible interpretations of expressions of metaphysical modality vindicate the truth of no-shifts, interpretations can nevertheless differ over the answers to our awkward haecceitistic modal questions, which seemed answerable only in an arbitrary and unprincipled manner. Returning to one of our examples above, suppose we live in some nomic possibility where the tip of my nose is located at spacetime point o . We now ask whether it’s metaphysically possible for reality to have had such-and-such maximal qualitative description (for instance, for everyone to have been standing, but otherwise we depart minimally from the qualitative way things actually are) and for the tip of my nose to still be located at o . Given no-shifts, we saw that every maximal qualitative description has a unique non-qualitative realization, and hence answering this question in the affirmative would seem to be wholly arbitrary. (Doing so would imply that it’s *impossible* for reality to have had that maximal qualitative description and for my bellybutton, rather than my nose, to be located at o . Yet what could privilege the nose-at- o possibility over the bellybutton-at- o alternative?) However, adopting Lewis’ view, proponents of no-shifts can claim that, in every context, some admissible interpretations of ‘metaphysically possible’ answer the question in the affirmative, and others answer it in the negative, yet all admissible interpretations agree on no-shifts. They can then argue that this claim renders it vague which such operator is invoked in every context. The result is that, although it’s determinate that the awkward haecceitistic modal questions have unique answers (because all interpretations agree on no-shifts), no such answer is privileged over any other, because it’s vague which answer is true. It seems, then, that proponents of no-shifts can avoid the charge that whatever answer they give would be objectionably arbitrary.

³⁴Lewis himself would not have accepted this application of his view: he thought that in many contexts the modal doctrine of no-shifts (and hence also anti-haecceitism) is false. He called himself only a “cheap haecceitist,” however, because of his modal realist metaphysic of possible worlds, which he thought could come apart from the *possibilities* at issue when we make modal speeches like anti-haecceitism. My own view is that this two-level aspect of his theory of modality is problematic, and the role of worlds in his theory is opaque at best, given their failure to satisfy standard connections between possible worlds and the modal operators. (For versions of this criticism, and why Lewis is arguably a haecceitist in the sense that matters, see Skow (2008), Kment (2012), and Belot (2018). For further discussion see Russell (2014, 2015), whose views I discuss in section 6.) Of course Lewis’ view also leaves open that in some contexts we invoke an especially strict counterpart relation which renders anti-haecceitism (and hence no-shifts) true.

My central worry for this Lewis-inspired view—which I suspect would also plague any other view that blames the sought after vagueness on metaphysical modality itself—is that on Lewis’ view there is a much better candidate to be meant by our talk of metaphysical modality than whichever of the countless counterpart-relation-relative operators happen to get picked out in any given context. Recall that metaphysical modality is meant to be some reasonably natural modal notion, latching onto what is necessary or possible in some absolute or widest sense. Now these platitudes have been challenged, and require further work to be made precise.³⁵ But something in the vicinity is undeniably central to our understanding of metaphysical modality. For instance, recall Kripke’s memorable and oft-cited qualification when discussing the necessity of identity: “here of course I don’t mean just physically necessary, but necessary in the highest degree—whatever that means” (1980, 99). And given Lewis’ view, there is a very wide and reasonably natural candidate to be meant by our talk of metaphysical modality, and one that much better coheres with the glosses that were used to introduce the notion in the first place. In particular, metaphysical possibility can be understood as the disjunction of all of the numerous possibility according to such-and-such counterpart relation operators; that is, to be metaphysically possible is to be possible according to *some* counterpart relation. (Metaphysical necessity is then understood using the standard dual equivalences, as the conjunction of all of the numerous necessity according to such-and-such counterpart relation operators; that is, to be metaphysically necessary is to be necessary according to *every* counterpart relation.) Yet once we make this natural identification, which is much more plausibly what our expressions of metaphysical modality latch onto in Lewis’ framework, the entire reply under discussion collapses: our expressions of metaphysical modality, properly interpreted, turn out to be precise and context-invariant after all. Of course we might also use our modal vocabulary in many contexts to talk about only some of the countless restricted operators, but in doing so we would not be expressing metaphysical modality, which is the sense of modality at issue in both anti-haecceitism and no-shifts. (Recall that we are understanding nomic possibility at a world to simply be metaphysical compossibility with the laws of that world, and writing throughout as if our actual laws are those of GR.)

An analogy that may be helpful here is the doctrine that we should give up the S4 axiom for metaphysical modality, advocated by Chandler (1976) and Salmon (1989) in response to Chisholm’s (1967) puzzle about the degree of modal tolerance of the constitution of material objects. The S4 axiom says that all propositions that are possibly possible are also possible. A standard reply to S4-deniers is that we can define much more natural operators to be meant by our talk of metaphysical modality in their S4-free setting, operators which better cohere with the standard glosses used to introduce the notion of metaphysical modality, and moreover these more natural operators would obey S4.³⁶ In particular, to be

³⁵For challenges and relevant discussion, see Sider (2011, ch12), Fritz (2017), and Clarke-Doane (2019).

³⁶Notably, to name just one example, I think this is exactly the concern Lewis himself is pressing in the following passages, appealing to the distant possibilities that are accessible to S4-deniers only via iterated

metaphysically possible amounts to being possible or possibly possible or possibly possibly possible, and so on. (Similarly, our talk of metaphysical necessity is best interpreted as the conjunction of all iterations of the necessity operators alleged not to obey S4.) What I am suggesting here is that an exactly analogous reply can be made to Lewis' attempt to explain how metaphysical modality can be a distinctive source of vagueness, given the presence of a much more natural operator to be meant in his framework, and one which is truer to our referential intentions when speaking of metaphysical modality.

I should add that one may have independent reasons to think that metaphysical modality is fundamental, or at least not a source of vagueness; this is a view I'm sympathetic to, and one which is reasonably prevalent amongst modal metaphysicians. The doctrines we'll offer proponents of no-shifts in the rest of the paper will be compatible with this and other orthodox options from debates in the metaphysics of modality.

We see, then, that we should reject the option of sourcing the indeterminacy in the relevant haecceitistic modal propositions about spacetime in the notion of metaphysical modality itself. But the only other resource needed to pose the questions at issue in the modal arbitrariness challenge (setting aside logical vocabulary) is our talk of spacetime points themselves. Those seeking to rescue the consensus substantialist position of no-shifts are thus forced to examine a view where the notion of metaphysical modality is determinate, yet the very notion of a spacetime point might be a source of vagueness. I now turn to developing what I think a view of this sort must look like; in particular, a view according to which spacetime points and regions are subject to plenitude. Afterwards, I'll explain why other approaches to developing a view of this sort are problematic.

5 Plenitudinous Substantivalism

5.1 Background on Plenitude

Let me start by briefly explaining what a plenitudinous view says, and some of its motivations, in the familiar setting where such a view appeared, namely the metaphysics of material objects. Some version of plenitude is widely held amongst those working in the area, and is often regarded as the most promising extant proposal.³⁷ The idea of there being *some* coincident objects is a common reply to the classic puzzles of material constitution, and arguments by Leibniz's law. For example, this statue could not have survived being squashed, but the lump of clay it's made of can, so the statue and the lump are dis-

possibility operators: "Say I: this is no defence, this is capitulation. In these questions of haecceitism and essence, by what right do we ignore worlds that are deemed inaccessible? Accessible or not, they're still worlds. We still believe in them. Why don't they count?" (1986, 246), and "There are things such that, ignoring them, there are no such things. Ignoring all the worlds where such-and-such obnoxious things happen, it is impossible that such things happen. Yes. Small comfort" (1986, 248).

³⁷Proponents abound; for a sampling, see Yablo (1987), Sosa (1987, 1999), Fine (1999), Hawthorne (2006a), Leslie (2011), Dasgupta (2018), Fairchild & Hawthorne (2018), Fairchild (2019), and Spencer (2020). See also Bennett (2004) for discussion (though Bennett does not espouse a plenitudinous view).

tinct by Leibniz's law, despite being spatiotemporally, and perhaps also mereologically, coincident.³⁸ Notice also that the well-worn "problem of the many" reveals that just about everyone countenances a plenitude of *nearly* coincident objects; for instance, in the vicinity of the table in front me are an abundance of collections of particles, differing only negligibly from each other.³⁹

Plenitudinous views of material objects go further than either of these forms of coincidence, embracing an abundance of *exactly* coincident objects. As a warmup, let me rehearse one common style of argument for the view.⁴⁰ Suppose I take the lump of clay before me and sculpt a statue of David Lewis. You then say 'I better be careful not to knock off your statue's beard: if I were to do so I'd destroy your statue of David!'. It's easy to get into a frame of mind where you have spoken truly, and hence in the vicinity of the original statue is an object that could not survive losing its beard. But it's also easy to imagine a context where English speakers, or at least some alternative speech community, would instead make utterances like 'I better be careful not to knock off your statue's beard: if I were to do so, your statue of David would be beardless and look so different'. The arguments then appeal to the plausible judgment that we shouldn't regard only the former reaction as somehow tracking the true facts about whether statues can survive changes akin to losing their beards. The judgment is often further motivated by an anti-arbitrariness premise, or charity to use, or the plausible claim that the ontology of the world shouldn't be anthropocentric. The arguments then use this judgment to motivate a form of coincidence: all along there were coincident objects in the vicinity of my statue of David, one which could survive losing its beard and one which could not. And it's easy to see that these cases can be generalized to no end, given the flexibility of our actual linguistic practice, the numerous possible respects of variation cases may target, plus the multitude of alien linguistic conventions we can conceive of. Proponents of plenitude then finally try to state some simple general principle to generate the requisite plethora of coincident objects with different modal profiles, in accordance with a plausible methodology that metaphysics should seek such simple general principles rather than proceeding piecemeal on a case by case basis.

Delicate issues arise when trying to write down a consistent general doctrine of plenitude, and proponents of the view often differ over the details. Here's one way to get at the idea. We take for granted some bottom-level of fundamental material objects (such as certain fundamental particles, strings, and so on), which are the parts out of which all material objects are composed. Let's call them the *fundamental objects*. Provided we take these fundamental objects to not themselves require a plenitudinous treatment, we can take them as given in generating a plethora of composite mereologically coincident material objects,

³⁸For a prominent defense of coincidence, see Thomson (1998).

³⁹For a canonical statement, see Unger (1980).

⁴⁰Some version of the argument in this paragraph appears in most of the defenses of plenitude cited in footnote 37. For further discussion of arguments in this spirit (which also figure prominently in discussions of perdurantism and mereological universalism), see Van Cleve (1986), van Inwagen (1990, 124-26), Sider (2001, 156-57; 2007, 260-61), Hawthorne (2006b, 109), and Korman (2010; 2015, ch.8).

as follows:

Material-Object-Plenitude Necessarily, for every property F that some fundamental object instantiates, there is some object x such that, necessarily: (i) x exists if and only if some fundamental object is F , and (ii) if x exists then x is composed of exactly the fundamental objects that are F .

First, notice that this principle delivers objects beyond just the numerous coincident objects we motivated above. Let F be qualitative, say the property of being a part of something triangular. Material-object-plenitude then delivers us an object that, necessarily, exists iff some fundamental object is a part of something triangular, and that at such possibilities is composed of exactly the fundamental objects that are a part of something triangular. As a result, at possibilities like our own where there are numerous disjoint triangular things, this object would be a scattered fusion of all of the triangles, familiar from discussions of mereological universalism. Still, these objects are arguably also supported by anti-arbitrariness and anti-anthropocentrism considerations.

To see how material-object-plenitude delivers us the requisite abundance of coincident objects, let's return to our statue of David example. Let oo be the fundamental objects that I in fact use to sculpt my statue (beard and all), and let F be the following (non-qualitative) property: is a part of some object that is (i) shaped like a statue with a beard and (ii) has as parts some non-empty subset of the fundamental objects oo .⁴¹ Then material-object-plenitude ensures that there is some object that, necessarily, exists iff some fundamental object is F and at such possibilities is composed of exactly the F fundamental objects. This object is wholly located in front of me after I sculpt my statue, yet it does not survive at a possibility where you knock off its beard. Analogous reasoning, with a different instantiation of F , gives us an object in front of me when I sculpt my statue which could survive losing its beard, and so on for any degree of variation along any parameter of variation whatsoever. Given the unrestricted nature of material-object-plenitude, it's not hard to see how the principle will deliver us all of the objects (with particular modal profiles) that we might ever need to temper worries about arbitrariness, charity, or anthropocentrism, and more objects besides!

5.2 The Doctrine Stated

How might proponents of no-shifts state an analogous plenitudinous doctrine to address my challenge from modal arbitrariness?

⁴¹The inclusion of conjuncts like (ii) is to control for the possibility of qualitative symmetries: if there is a qualitative duplicate of my statue of David elsewhere in the universe, then a purely qualitative choice of F will deliver us a scattered object, not an object wholly located in front of me after I sculpt my statute. I will generally ignore the need for such maneuvers in what follows, though analogous qualifications can be used to address worries about multiply instantiated properties.

Right away a question arises. The doctrine we're after will say that where we used to think there is one spacetime point, there are now a plethora of coincident point-like objects, differing over how they answer our awkward modal questions from section 3. But what does "coincident" mean here? In stating material-object-plenitude, we took for granted a base of fundamental objects not subject to plenitude, and used these to generate a plethora of mereologically coincident objects. The other standard notion of coincidence is spatiotemporal coincidence, defined as being located at exactly the same spacetime points, where these in turn are taken for granted. But neither of these models will suit our purposes. We want the spacetime points themselves to be subject to plenitude, which rules out spatiotemporal coincidence as standardly understood. And, at least in our setting of GR, spacetime points are taken as mereological simples, not themselves composed of more fundamental objects. What to do?

Let me first state the informal idea behind plenitudinous substantivalism, and then afterwards make this informal idea precise. At all possibilities spacetime consists of some objects standing in some network of spatiotemporal properties and relations. Whereas we used to think there was one object at each node in such a network (a spacetime point), the plenitudinous vision will instead maintain that there is a plethora of objects at each node. The plethora of objects at each node will all agree on their qualitative non-modal properties, yet they will differ in the modal respects required to render vague the answers to our awkward modal questions from section 3. Already we can glean the sense in which this plethora of objects at each node will be coincident: they will all play the same spatiotemporal role, understood as standing in the same qualitative and non-qualitative pattern of spatiotemporal properties and relations to the same objects at every other node. It will be helpful to have a name for the objects, an abundance of which will be at each node in every possible network of spatiotemporal properties and relations: let's call them the *quasi-points*.

This plenitudinous vision then claims that 'spacetime point' is vague, where the admissible interpretations are given by properties of quasi-points, yet, on every admissible interpretation of 'spacetime point', the sentence 'only one member of every equivalence class of coincident quasi-points is a spacetime point' is true. As a result, determinately our ordinary talk of any given spacetime point is referring to only one member of the equivalence class of coincident quasi-points at the relevant node in spacetime, yet it's indeterminate which such quasi-point in the equivalence class gets picked out. This claim about the vagueness of 'spacetime point' is plausible because we normally refer to spacetime points via their spatiotemporal roles, or in terms of the patterns of matter fields instantiated at them, and every member of every equivalence class of coincident quasi-points will agree on these non-modal questions.⁴² Moreover, embracing a plenitude of quasi-points with-

⁴²More precisely, coincident quasi-points occupy the same node in whatever network of spatiotemporal properties and relations obtains. Hence, they will all agree on their qualitative non-modal spatiotemporal profiles full-stop; and agree on their non-qualitative non-modal spatiotemporal profiles concerning every object at

out appealing to vagueness in this way leads to problems. For instance, if one were to claim that ‘spacetime point’ determinately expresses the property of being a quasi-point then most central claims that GR makes about spacetime points would turn out false; for instance, that spacetime points form a smooth manifold, or that no spacetime points coincide.

Exactly the modal indeterminacy needed by proponents of no-shifts follows immediately. For the coincident quasi-points that are admissible interpretations of our thought and talk of any given spacetime point all differ in the relevant aspects of their modal profiles (where these modal profiles are precise, given our arguments above that metaphysical modality isn’t a distinctive source of vagueness). As a result, our ascriptions of modal properties to any given *spacetime* point will be vague, given that it’s vague which quasi-point our talk about that spacetime point is referring to. We thus have the modal indeterminacy we wanted. Yet, unlike Lewis’ view, the source of this modal indeterminacy is only the notion of a spacetime point itself: no problematic assumptions in modal metaphysics are needed. Notice also that all of our non-modal talk about spacetime will turn out perfectly determinate and be left untouched, given that all coincident quasi-points at each node agree on their field values (of both the metric field and matter fields). We’ll see in section 6 that extant views in the same family as the plenitudinous metaphysics we’re developing cannot secure this result. Plenitudinous substantivalism thus seems to deliver vagueness where and only where proponents of no-shifts need it, and sources this vagueness in the right place.

Let’s now make this informal vision precise. We must first define the notion of a *purely* spatiotemporal property. We want our plenitudinous doctrine to generate a plethora of objects at each possibility that intuitively “play the spacetime point role” at that possibility, which requires the objects to instantiate spatiotemporal properties and relations.⁴³ Yet delicate issues arise when we consider possibilities with objects in addition to spacetime points, say non-GR possibilities that in place of matter fields contain material objects like particles. There’s a natural sense in which this particle’s property of being two feet from that one is a spatiotemporal property. Yet we don’t want our statement of plenitudinous substantivalism also to generate a plenitude of particles at possibilities like these. Similarly, we also need to rule out conjunctive properties that conjoin some requirement on non-spatiotemporal subject matter to some spatiotemporal property; for these conjunctive properties are still spatiotemporal in a sense. The notion of a purely spatiotemporal property is meant to rule out such problem cases, intuitively giving us only the properties at each possibility that are instantiated by the objects playing the spacetime point role at that

every *other* node in spacetime.

⁴³I will continue to treat the notion of a spatiotemporal property or relation as primitive. Perhaps there is something reasonably precise to say in non-spatiotemporal terms about what makes a property spatiotemporal; for instance, playing certain roles in the dynamical laws. But I won’t discuss this issue here. For relevant discussion, see recent work on “spacetime functionalism,” such as Knox (2019).

possibility, and characterizing only their spatiotemporal features.

I start with the notion of the most fundamental spatiotemporal properties and relations instantiated at each possibility.⁴⁴ I take it that at possibilities with material objects in addition to spacetime, the most fundamental spatiotemporal properties and relations will nevertheless be instantiated only by spacetime itself: the spatiotemporal properties and relations instantiated by material objects at such possibilities obtain in virtue of non-spatiotemporal facts about which parts of spacetime those objects are located at, plus more fundamental spatiotemporal facts involving only spacetime. Similarly, the problematic conjunctive properties from the previous paragraph will not be amongst these most fundamental instantiated spatiotemporal properties and relations: facts involving them will obtain in virtue of facts involving only the properties described in each conjunct. Of course there's an interesting and open question about what the most fundamental spatiotemporal properties and relations instantiated at any given possibility are, including possibilities where GR is true, but this question needn't detain us here.⁴⁵

We define the purely spatiotemporal properties as those that are the most fundamental spatiotemporal properties instantiated at some possibility, or amongst the qualitative and non-qualitative properties we can define from the most fundamental spatiotemporal properties and relations instantiated at some possibility. Here by 'definition' I intend those properties we can construct from the original group using first-order logic (without identity), lambda abstraction, plus names for other objects. For example, suppose amongst the most fundamental spatiotemporal properties or relations instantiated at some possibility is a two-place 'is adjacent to' relation R . Then amongst the purely spatiotemporal properties are: the property of standing in R to something, the property of standing in R to a , the property of being such that if Rab then you either stand in R to a or stand in R to b , the property of standing in R to exactly the same things as a , and so on. We see then that the purely spatiotemporal properties include both qualitative and non-qualitative properties. These properties also range from simple properties of the sort just given, all the way up to extremely complex conjunctive properties requiring an object to play a specific spatiotemporal role in some maximal qualitative and non-qualitative pattern of instantiation of spatiotemporal properties and relations, disjunctions of these extremely complex conjunctive properties, and so on.

With this definition in hand, we can state the following take on the target plenitudinous

⁴⁴I will assume that facts about which properties and relations are fundamental, or more fundamental than others, are non-contingent. Of course, I allow for contingency in which such properties are instantiated. I could rephrase all of what follows more clumsily so as to drop this assumption, however.

⁴⁵Arguably the relevant properties and relations will call for an *intrinsic* formulation of the physics of each possibility, in the sense of Field (1980). And the options here then require us to get embroiled in difficult questions in the metaphysics of spatiotemporal quantities. For instance, perhaps at Newtonian possibilities the most fundamental instantiated spatiotemporal properties and relations are just a betweenness relation, a congruence relation, plus some property to single out the temporal dimension. What the corresponding intrinsic spatiotemporal properties and relations may be at possibilities like those where GR is true is an open issue. For some options here, see Forrest (2009) and Arntzenius & Dorr (2012).

doctrine:

Unrestricted-Plenitudinous-Substantivalism Necessarily, for every instantiated purely spatiotemporal property F , there is some object x such that, necessarily: (i) if something is F then x exists, and (ii) if x exists then x is F .⁴⁶

Unrestricted-plenitudinous-substantivalism addresses the modal arbitrariness challenge in an analogous manner to material-object-plenitude: the doctrine delivers us objects with a vast range of spatiotemporal modal profiles, thereby delivering us our plethora of coincident quasi-points. Let's walk through some examples. Suppose we live in some nomic possibility; hence, given the laws of GR, the matter fields corresponding to the tip of my nose are instantiated by a point that thereby also has some specific qualitative curvature property, which reflects the curvature generated by the stress-energy corresponding to the tip of my nose.⁴⁷ Now instantiate F in our doctrine with the property of having that qualitative curvature property, which can be spelled out as a purely spatiotemporal property. Unrestricted-plenitudinous-substantivalism then delivers a quasi-point where the tip of my nose is located whose modal profile requires that it still be where my nose is located at a nomic possibility where everyone is standing now instead of sitting (but which otherwise departs minimally from the qualitative way things are).

Yet also at the nomic possibility we live in, the tip of my nose is two-feet from the matter field corresponding to the handle of my coffee mug, which is instantiated by a region having some specific qualitative curvature property (generated from the stress-energy corresponding to the handle). Now instantiate F in our doctrine with the property of being two-feet above an object having that specific qualitative curvature property. Again this can be spelled out as a purely spatiotemporal property, using whatever fundamental properties and relations at nomic possibilities are required to characterize distance and curvature. Unrestricted-plenitudinous-substantivalism now delivers us a new quasi-point, also exactly where the tip of my nose is located, yet with an altogether different modal profile. In particular, this quasi-point's modal profile ensures that at the nomic possibility where everyone is standing now instead of sitting (but which otherwise departs minimally from

⁴⁶This doctrine does not give us a plenitude of quasi-points differing over their modal profiles with respect to properties that concern what matter fields are instantiated at them, or which material objects are located at them, except indirectly at worlds with laws like those of GR where the behavior of matter supervenes on purely spatiotemporal properties (though recall from footnote 10 that this statement needs to be qualified). This feature was deliberate, given my focus here on no-shifts, and hence on GR. For anti-haecceitists to try to use a plenitudinous doctrine to address my modal arbitrariness challenge in general, including at possibilities where the behavior of matter can float free of the behavior of spacetime, they would need to generalize this doctrine to encompass material objects and matter-centric properties of the sort just mentioned. My arguments in section 7 against unrestricted-plenitudinous-substantivalism itself apply even more starkly to this strictly stronger generalization of the doctrine, but I won't discuss the details here.

⁴⁷Some clarifications: (i) curvature is an extrinsic property of points, given that the curvature at a point depends on features of the point's immediate neighborhood in spacetime, (ii) of course the tip of my nose would in fact correspond to an extended region not a point, but nothing turns on this simplification, and (iii) I'll also simplify things by assuming that the relevant curvature property is not multiply instantiated at the nomic possibilities I discuss.

the qualitative way things are), it will *not* be where my nose is located (which is now more than two-feet above the handle of my mug). Instead it will be where my belly-button is located.

We see now that we have two coincident quasi-points, which answer one of our awkward modal questions from section 3 in different ways. Exactly like material-object-plenitude, we can right away see that these examples generalize indefinitely: unrestricted-plenitudinous-substantivalism gives us more objects playing the spacetime point role than one could ever need to address the modal arbitrariness challenge. There is no end to the purely spatiotemporal properties we might plug into the principle to deliver us quasi-points with whatever degree of modal tolerance we wish, across any spatiotemporal parameter of variation whatsoever. It thus looks as if we've found a doctrine that might save proponents of no-shifts. Unfortunately, I'll argue in section 7 that this doctrine, as well as any variant on it that one might concoct, is vulnerable to my challenge from cheap determinism.

One final point before moving on. Notice that unrestricted-plenitudinous-substantivalism is silent on which qualitative possibilities there are, thereby rendering the doctrine consistent with anti-haecceitism and hence no-shifts. The doctrine simply imposes a fullness constraint on what objects there are at whatever possibilities there are: wherever purely spatiotemporal properties are instantiated at multiple possibilities, the doctrine delivers objects existing exactly where those properties are instantiated. Of course unrestricted-plenitudinous-substantivalism does not *imply* anti-haecceitism or no-shifts. So haecceitists who reject no-shifts could in principle embrace the doctrine (though they aren't vulnerable to the modal arbitrariness challenge, so it's unclear why they would be inclined to do so). But the important point is that nothing in the doctrine of anti-haecceitism or no-shifts precludes one from consistently adopting unrestricted-plenitudinous-substantivalism to try to address my modal arbitrariness challenge.⁴⁸

6 Alternatives

My modal arbitrariness challenge left proponents of anti-haecceitism or no-shifts with a dilemma: super demanding modal essences or wholly arbitrary modal essences. The first horn faltered on the problem of cheap determinism, so we have been exploring how best to conscript vagueness to render the second horn more palatable. We saw the Lewis-inspired option of sourcing the requisite vagueness in metaphysical modality itself to be independently problematic. That forced us to source the requisite vagueness in the notion of a spacetime point or region, which led us to develop the strange and unfamiliar metaphysic

⁴⁸One other point worth flagging is that proponents of no-shifts might want to embrace unrestricted-plenitudinous-substantivalism while preserving the determinacy of certain modal judgments about spacetime points; for instance, that determinately it's necessary that no two *spacetime* points possibly coincide, despite it being determinate that possibly non-coincident *quasi*-points possibly coincide. I don't think this is cause for concern, however: one can simply countenance additional penumbral constraints satisfied by all admissible interpretations of 'spacetime point' to secure such modal judgments.

of plenitudinous substantivalism. In the next section I'll argue that this doctrine too is vulnerable to cheap determinism, and hence my modal arbitrariness challenge to anti-haecceitism and no-shifts stands. But you might first be wondering whether there are other less strange options for rendering the second horn more palatable. So let me review the extant views in the relevant family, and explain why they're problematic. These considerations are what lead me to regard plenitudinous substantivalism as the only hope for proponents of anti-haecceitism or no-shifts seeking to champion the second horn of my dilemma.

The first class of views in the vicinity are those that take all haecceitistic modal propositions about spacetime (whether about particular spacetime points or regions) to have some defective status, yet which don't also extend this status to the corresponding non-modal propositions about spacetime. On these views, there is something defective about the entire enterprise of asking haecceitistic modal questions about spacetime, within which my modal arbitrariness challenge arises. There are numerous proponents of views of this sort, and the supposed defective status is expressed in almost as many different ways: sometimes the view is expressed as denying that that spacetime points, and hence regions, "have primitive identity," or "can be individuated" across possibilities; at other times the view is expressed as simply denying that there are haecceitistic modal facts about spacetime.⁴⁹ To give just one example, Hoefer (1996, 14-15) says that questions about shift-related possibilities "make no sense" once we follow him in abandoning "the ascription of primitive identity to spacetime points."

As a first concern for views in this family, let me just confess that I have very little handle what these views are meant to be claiming. Like many, I find the glosses above—involving ideology like what has "primitive identity," or what "can be individuated" across possibilities—opaque and obscure if not just colourful ways to express some precise first-order modal doctrine like anti-haecceitism or no-shifts (compare Sider (2006; 2020, ch.3), Dasgupta (2011) and Williamson (2013, ch.1)). By contrast, notice that plenitudinous substantivalism is a precise and intelligible doctrine that employs only the familiar ideology of vagueness in vindicating the impulse to ascribe some second-rate status to our awkward haecceitistic modal questions about spacetime in the modal arbitrariness challenge, without any mystery-mongering about "primitive identity," and so on.

Even given my tenuous handle on the sorts of views under discussion, I think there is a further objection we can make. Suppose one shares the impulse that questions like our

⁴⁹Many of the works cited as proponents of anti-haecceitism or no-shifts in footnote 14 also make claims of this more deflationary sort, which I'll criticize here. Notice that claims to the effect that certain modal propositions have some problematic status are altogether different from a first-order modal doctrine like anti-haecceitism or no-shifts, despite many of the cited authors moving interchangeably between the different kinds of views. Often yet another distinct doctrine about mathematical solutions of the sort I criticized in section 2 is thrown in as well; indeed often all three are discussed interchangeably under the same label. And again, 'sophisticated substantivalism' and 'spacetime structuralism' are at times used to describe doctrines of all three sorts and more besides. In an effort not to make the situation even more chaotic, I'm avoiding these labels.

awkward haecceitistic modal questions about spacetime from section 3 are somehow bad questions, and answers to them should have some second-rate status. Nonetheless, one may not want to extend that second-rate status to the answers to *all* haecceitistic modal questions about spacetime. For instance, one may want to withhold that second-rate status from plausible haecceitistic modal judgments like that spacetime point *o* is necessarily self-identical, or that spacetime point *o* could not have been a fried egg, and so on. And notice that plenitudinous substantivalism can make good on this desire: the doctrine allows that many haecceitistic modal questions we might ask about spacetime have determinate answers, provided all coincident quasi-points at some node agree on the issue. For instance, the view predicts that, necessarily, for every spacetime point *o*, determinately *o* is necessarily self-identical. And the view can easily be paired with an essentialist doctrine predicting that, necessarily, for every spacetime point *o*, determinately *o* is necessarily not a fried egg. Thus the doctrine has the ability to be *selective*: extending a second-rate status only to some haecceitistic modal propositions about spacetime (for instance, only those needed to address the modal arbitrariness challenge). Yet the deflationary views under consideration, with their wholesale rejections of “primitive identity” or “individuation across possibilities” for spacetime points (whatever these glosses mean), seem unable to make such fine-grained discriminations: their doctrines are designed to somehow render defective all haecceitistic modal propositions about spacetime whatsoever, which I view as something of a reductio.⁵⁰

I now turn to views that attribute some second-rate status to some haecceitistic modal propositions about spacetime but which in addition attribute that same status to the corresponding non-modal propositions. Notice that plenitudinous substantivalism is a view of this sort, given how it ascribes vagueness to the haecceitistic modal questions about spacetime at issue in the modal arbitrariness challenge, yet sources this vagueness in our non-modal thought and talk about spacetime points and regions. It just combines these commitments with a metaphysical doctrine that ensures we don’t end up with non-modal vagueness, given that the chief respect in which coincident quasi-points differ is over their modal profiles.⁵¹ The other option of this sort is the view carefully developed by Russell (2014, 2015). Let me outline Russell’s view, and explain why I find it problematic.

Russell employs a primitive “factuality” operator. He then proposes that only qualitative propositions are factual. As a result, the haecceitistic propositions at issue in questions

⁵⁰A potential third objection, due to Russell (2015, 2016), is that arguably the very structure of these views is unstable. In particular, it is difficult to maintain that somehow haecceitistic modal propositions about spacetime have a second-rate status without also extending that status to the corresponding non-modal haecceitistic propositions about spacetime. The details would take us too far afield, but Russell (2016, section 4) argues that problematic statuses for modal claims “infect” non-modal subject matters, via the T-axiom. He takes this worry to support his (2014; 2015) views, where even non-modal haecceitistic propositions about spacetime receive a second-rate status, to which I turn now in the main text.

⁵¹The “chief respect” hedge here is because coincident quasi-points also differ over certain non-qualitative non-modal properties (for instance, each will be identical to itself and not any other coincident quasi-point), but these won’t render any non-modal sentences only about *spacetime* points vague.

of shifts, or in my modal arbitrariness challenge, would turn out to be non-factual. Thus, although Russell allows for mere non-factual haecceitistic differences (his “possibilities”), anti-haecceitism is trivially true for possibilities constructed out of the factual propositions (his “possible worlds”), which are all qualitative propositions.

I have three concerns about Russell’s proposal. The first stems from his primitive factuality operator. Russell does a noble job trying to elucidate what role this operator is meant to play: drawing on numerous debates which he thinks are best regimented as debates over what’s factual. I won’t review these here (though see footnote 52). Instead, I’ll just note that once what would seem to be paradigms of factual propositions are declared non-factual, my grip on what the claims of factuality at issue consist in starts to weaken. For instance, mundane haecceitistic propositions like that I am sitting, or that I am looking at a computer, are deemed non-factual by Russell, despite seeming like exemplars of factuality given the role that notion plays in other debates.⁵² And again, notice the glaring contrast with plenitudinous substantivalism, which secures the desired deflationary results using only the more familiar ideology of vagueness, while also explaining why this vagueness occurs, with no need for anything like a primitive factuality operator.

My second concern is again the issue about selectiveness: Russell’s view declares *all* haecceitistic non-modal propositions non-factual. And even if we instead understand his factuality operator in terms of vagueness or determinacy, in order to avoid the previous concern, the analogue of his view would declare *all* haecceitistic non-modal propositions indeterminate. Thus mundane non-modal facts about spacetime turn out to be non-factual or vague for Russell: for instance, that spacetime point *o* has such-and-such field value, that this spacetime point is five feet from that spacetime point, and so on. And the worry now is that we have carried the initial deflationary impulse too far. Recall that, by contrast, plenitudinous substantivalism secures the desired results while still rendering all non-modal propositions about spacetime perfectly determinate.

A third concern is that Russell’s view undermines some of the motivation for embracing no-shifts in the first place. The view is thus ill-suited to save proponents of no-shifts from the modal arbitrariness challenge. I’ll discuss this further in the conclusion, but the doctrine we’ll end up with is a haecceitist substantivalism, which rejects no-shifts and instead tries to undermine the usual motivations for this standard modal desideratum. And we saw that arguably the central such motivation stems from the hole argument, and rescuing GR’s determinism. The haecceitist anti-no-shifts response here is that we should

⁵²Matters are made worse given some of the example debates Russell employs from the philosophy of physics, such as the debate over the reality of gauge potentials in electromagnetism. Here it seems some parties in the debate want to declare these potentials to be merely representational, akin to choice of font when writing a sentence. Yet this “merely representational” status is quite different from other examples Russell employs in illustrating what lacking factuality amounts to, for instance the status anti-realists want to ascribe to ethical facts. If ‘non-factual’ is being used in a sufficiently general sense to encompass such disparate cases, then the concern is that it’s unclear what we’re supposed to make of the claim that all haecceitistic propositions are non-factual.

be invested in rescuing determinism only in some restricted sense; for instance, requiring only determinism as concerns *qualitative* propositions, which GR is taken to vindicate by all parties in the debate.⁵³ Yet notice that Russell's view also rescues determinism only in some weaker sense, namely determinism as concerns only the *factual* propositions: the view still accepts that *there are* haecceitistic threats to GR's determinism, it just deems all haecceitistic propositions non-factual. And of a piece with the obscurity of the factuality operator itself, which was my first concern, it's not clear why one should be satisfied with rescuing only determinism restricted to the factual, yet not have been satisfied with rescuing only determinism restricted to the qualitative from the get-go, which even those of us who reject no-shits can do.

For all of the above reasons, I take plenitudinous substantivalism to be where proponents of no-shifts seeking to take up the second horn of the dilemma posed by my modal arbitrariness challenge must place their allegiances. Whereas all other extant doctrines in the relevant family are independently problematic, plenitudinous substantivalism perfectly threads the needle with respect to all of the objections. The doctrine is precise, employs only unmysterious ideology (namely vagueness), explains why we find this deflationary status where and only where we want it (the relevant haecceitistic modal propositions about spacetime), and sources this status in the right place. I think this is exactly the sort of doctrine those discussed in this section, as well as self-described 'sophisticated substantivalists' and 'spacetime structuralists' (recall footnote 14), have been yearning to articulate. Unfortunately, we're about to see that, like demanding-modal-essences, plenitudinous substantivalism too faces cheap determinism.

7 Cheap Determinism Yet Again

The problem of cheap determinism arises when, necessarily, there are objects at each time whose modal profiles impose constraints about goings-on to their pasts or futures that might spoil determinism. These objects then ensure that, necessarily, potential counterexamples to determinism cannot arise, because any differences between possibilities that might spoil determinism get reflected in some difference at every time (namely, whether the possibilities contain an object at that time with the relevant demanding modal profile). Because the possibilities turn out not to agree on all propositions at any time, they trivially do not threaten determinism after all, even if the laws of nature at the possibilities might seem paradigms of indeterminism.

Here's one straightforward way to see that plenitudinous substantivalism, like demanding-modal-essences, is vulnerable to cheap determinism. Notice that among the plethora of quasi-points that unrestricted-plenitudinous-substantivalism generates at every possibil-

⁵³Something like this response on behalf of haecceitism is espoused by Brighouse (1997) and Melia (1999). For a defense of the dissenting view on behalf of proponents of no-shifts, see Belot (1995).

ity will be some with super demanding modal profiles, exactly akin to the modal profiles imposed by demanding-modal-essences. To generate these quasi-points, we need only instantiate F in the principle with a property that requires its instances to satisfy some quasi-point's complete non-qualitative spatiotemporal role. (That is, F will be the conjunction detailing exactly which fundamental spatiotemporal properties and relations some quasi-point stands in and which particular other quasi-points it stands in those relations to.) We then consider analogous instantiations of F for every quasi-point at each possibility, generating objects at each possibility with exactly the problematic demanding modal profiles that we already saw to lead to cheap determinism in section 3.

We can also illustrate the problem using *qualitative* purely spatiotemporal instances of F . Suppose we live at a metaphysical possibility where the laws of nature are silent on whether the universe spontaneously collapses into a spacetime singularity at any given time, irrespective of what conditions are in place leading up to that time. These seem like they should be an exemplar of laws that are indeterministic as concerns the spatiotemporal facts: there are two possibilities where these laws are true that seem to agree on all propositions for most of history until one but not the other spontaneously collapses into a spacetime singularity. Yet, suppose we live in the possibility where the final singularity occurs. Amongst the quasi-points at our possibility will be those generated by instantiating F in unrestricted-plenitudinous-substantivalism with the qualitative property *being n units of time before a final singularity*, for each choice of n (where these can be spelled out as purely spatiotemporal properties). Yet none of these quasi-points exists at the possibility exactly like ours yet without a final singularity. The possibilities thus differ at each time over some proposition about which particular quasi-points there are at that time. They therefore do not threaten determinism after all: the later difference about whether a singularity occurs gets indirectly encoded in earlier differences about which quasi-points there are, via their rich modal profiles. This is the cheap determinism problem all over again: unrestricted-plenitudinous-substantivalism, like demanding-modal-essences, renders the spacetime-centric threats to determinism we're focusing on metaphysically impossible.

I'll now consider three lines of response that proponents of demanding-modal-essences or plenitudinous substantivalism might adopt to try to avoid the problem, and argue that each fails.

Recall the informal statement of determinism we've been working with: some laws of nature are deterministic just in case no metaphysical possibilities where those laws are true that agree on all propositions at some time differ on some proposition at some other time. There's a question here of how to make the "at some time" qualifier precise. I prefer to do so using the notion of intrinsicality, giving us the following definition of what it takes for some laws L to be deterministic:

Determinism For all metaphysical possibilities w and w' where L is true, if there is a time t at both w and w' such that t has the same intrinsic properties at both w and w' , then

w and w' agree on the truth value of every proposition.⁵⁴

We need the intrinsic qualifier in order to exclude properties that directly encode information about other times as being amongst those we must consider when testing whether two possibilities agree at some time. For instance, consider the property *being a time ten years before a pink elephant pops into existence in Central Park*. If some time instantiates this property, it's nevertheless not one of the time's intrinsic properties. We must exclude such properties, otherwise trivially any laws whatsoever will turn out deterministic, even those silent on whether a pink elephant pops into existence in Central Park (because potential spoilers of determinism get directly encoded in some property at every other time, thereby ensuring that the possibilities fail to agree on all propositions at some time after all).

Now a first attempt to respond to the cheap determinism challenge goes as follows. Call a quasi-point *problematic* just in case it has a past or future looking modal profile of the sort that sufficed to reinstate the problem of cheap determinism. Now claim that, for all problematic quasi-points o , the property *containing quasi-point o* is an *extrinsic* property of any time that instantiates it. As a result, such properties are not amongst those we must consider when checking whether two possibilities agree on all propositions at some time in the process of testing for determinism. Analogously, proponents of demanding-modal-essence might try to block the threat of cheap determinism by claiming that, for all spacetime points o , the property *containing spacetime point o* is an extrinsic property of any times that instantiate it in light of their modal doctrine, which endows all spacetime points with very strong modal essences.⁵⁵

I think this reply is just mistaken, however. Given unrestricted-plenitudinous-substantivalism, it's true that, necessarily, for all problematic quasi-points o , necessarily if a time instantiates *containing quasi-point o* then it also instantiates some property that is uncontroversially extrinsic to the time (something like *being a time n years before/after such-and-such occurs*, where such-and-such is whatever is required by o 's future/past looking modal essence). Mutatis mutandis for the property *containing spacetime point o* , for all spacetime points o , given demanding-modal-essences. Yet I don't take these facts to cast doubt on the strong judgment that the properties *containing quasi-point o* or *containing spacetime point o* are intrinsic to times that instantiate them all the same, even granting the truth of the relevant doctrines

⁵⁴This is the status I called 'full determinism' in Teitel (2019b). A few qualifications. Arguably we should speak of arbitrarily small temporal intervals, rather than particular times, so as to allow rates of change into the initial data when testing whether some laws are deterministic. Also, I understand the 'intrinsic' qualifier to allow facts about any material objects wholly located at some time to nevertheless count as intrinsic properties of that time. Those worried about this could modify the definition to instead read ' t and any material objects wholly located at t have the same intrinsic properties at both ...'. These subtleties aren't relevant to the issues at hand, so I'll set them aside.

⁵⁵The response of avoiding my problem of cheap determinism by claiming that the properties at issue—those requiring times that instantiate them to contain some particular object with a problematic modal essence—are in fact extrinsic was first suggested to me by Nico Silins. The discussion in the paragraph that follows in the main text builds on footnote 35 of Teitel (2019b), where I first discussed an analogous response in a different setting.

in each case. The moral I instead draw is that, like so many other notions, intrinsicality can make hyperintensional distinctions of this sort.⁵⁶ Here's an example to drive this moral home. Suppose Kripke's doctrine of the necessity of origins is true, and that I originate from sperm *s* and egg *e*. Hence, necessarily if a time instantiates *containing me* then it also instantiates *being a time later than a time containing s and e*. Nevertheless, I think the former is an intrinsic property of the present time, whereas the latter is an extrinsic property of the present time. My verdicts about properties like *containing o*—where *o* is a problematic quasi-point, or a spacetime point that vindicates demanding-modal-essences—pattern in the same way. I like to summarize the upshot here as follows. The 'intrinsic' qualifiers rule out properties that *directly* encode information about other times, like our pink elephant property above. Yet the notion of directly encoding is hyperintensional: even though properties like *containing quasi-point o* (where *o* is problematic) or *containing spacetime point o* (given demanding-modal-essences) necessitate facts about other times, the properties only *indirectly* encode information about other times, and hence can still be intrinsic properties of times that instantiate them.

Turning to the second attempt to respond to the cheap determinism challenge, plenitudinous substantialists might simply modify unrestricted-plenitudinous-substantivalism by replacing its expressions of metaphysical necessity with expressions of nomic necessity (which recall we're understanding as truth at all metaphysical possibilities where the laws of GR are true). And similarly for proponents of demanding-modal-essences. They could then at least allow that laws which, unlike those of GR, seem to be exemplars of indeterminism in the spatiotemporal facts turn out indeterministic after all. The problem is that the resulting principles stated in terms of nomic modality would cry out for some deeper explanation in terms of some doctrine that holds with metaphysical necessity. It's hard to fathom how a doctrine like plenitudinous substantialism or demanding-modal-essences could be true only at possibilities where GR is true. Nothing in the laws of GR predicts that such a principle would be true. Thus the distinctively nomic versions of the principles must fall out as consequences of some doctrine that holds with some stronger grade of necessity, like metaphysical necessity. That is why we have been investigating doctrines of this sort.

A third reply is to try to restrict unrestricted-plenitudinous-substantivalism or demanding-modal-essences so as not to generate cheap determinism. I think this reply faces two problems.

First, there are technical issues even stating a precise restriction that could do the required work. Roughly, to avoid cheap determinism we need the restricted principle to leave us only with objects (whether spacetime points or quasi-points) that are *unproblematic*, in the sense of lacking past or future looking modal essences. Yet at many possibilities,

⁵⁶Notice also that, in the quasi-point case, if the purely spatiotemporal property *F* that generated some quasi-point *o* possibly has multiple instances then the two properties at issue aren't even necessarily coinstantiated, and hence can be distinguished even intensionally.

including our nomic possibilities where GR is true, there is no unique foliation of space-time into times, and hence no global sense to be made of talk of “past” or “future,” which makes it unclear what the precise restriction could be.

To illustrate this point, let’s walk through one example of how plenitudinous substantivalists might try to state a restricted doctrine (a similar dialectic applies to the analogous attempt to restrict demanding-modal-essences). The most promising method employs the notion of intrinsicity also at issue in the definition of determinism. Call a purely spatiotemporal property F *near-sighted* just in case, necessarily, the property *containing some object that is F* is intrinsic to any time that instantiates it.⁵⁷ The desire is that the near-sighted purely spatiotemporal properties are exactly those that generate unproblematic quasi-points (those with modal essences that do not directly encode information about goings-on to their pasts or futures). If that were right then, for all unproblematic quasi-points o , the property *containing o* (which, recall, is intrinsic to any times that instantiate it) would not even *indirectly* encode information about times distinct from those that instantiate it. Proponents of no-shifts might then try to use this notion to state the following restricted take on plenitudinous substantivalism:

Restricted-Plenitudinous-Substantivalism Necessarily, for every instantiated *near-sighted* purely spatiotemporal property F , there is some object x such that, necessarily: (i) if something is F then x exists, and (ii) if x exists then x is F .

But the problem with this doctrine is that, given the numerous possibilities with spacetimes that lack a unique foliation into times, almost no purely spatiotemporal properties will turn out near-sighted, and hence the doctrine won’t generate nearly enough quasi-points to address the modal arbitrariness challenge. Just focusing on GR, and setting aside plenitudinous substantivalism for a moment, every spacetime point is a part of many times, and, crucially, no two spacetime points are a part of exactly the same times (see footnote 16 for more on what times are at possibilities where GR is true). As a result, only intrinsic properties of spacetime points will turn out near-sighted. And when we turn to plenitudinous substantivalism, what’s true of distinct spacetime points will now be true of non-coincident quasi-points: only coincident quasi-points will belong to all of the same times, and this renders near-sightedness extremely hard to come by. To see this, suppose o_1 and o_2 are non-coincident quasi-points at some nomic possibility. Then any purely spatiotemporal property of the form *bearing R to o_2* that o_1 instantiates will not be near-sighted. Because o_1 and o_2 are non-coincident, they fail to be simultaneous relative to some foliation of the possibility into times. So consider a time in some such foliation that contains o_1 but

⁵⁷As noted in footnote 54, arguably the initial data when testing for determinism is defined only along temporal intervals, rather than particular temporal instants. If so, the definition of near-sighted purely spatiotemporal properties must also be modified accordingly, replacing mention of particular times with temporal intervals. I ignore this issue in the main text for ease of exposition, writing as if even rates of change can be intrinsic to particular instants.

not o_2 . This time instantiates *containing some object that bears R to o_2* , but the property is extrinsic to the time. Hence, the original property *bearing R to o_2* fails to be near-sighted.⁵⁸

There are more restrictions we might consider, both of demanding-modal-essences and unrestricted-plenitudinous-substantivalism. Yet none I've managed to come up with avoids problems at possibilities with spacetimes that lack unique foliations into times, akin to the problem just outlined.⁵⁹

There's also a second more general issue we can raise against the very strategy of trying to address cheap determinism by restricting the relevant doctrines. In particular, the restricted doctrines have the feel of ad hoc fixes, and are much less simple and elegant than the original doctrines of demanding-modal-essences and unrestricted-plenitudinous-substantivalism themselves. It thus would strike me as something of an embarrassment for proponents of anti-haecceitism or no-shifts if they were forced to appeal to such contortions in order to successfully save their doctrines from my modal arbitrariness challenge.

We've seen that all three replies to try to free demanding-modal-essences and plenitudinous substantivalism from cheap determinism fail. I thus take the cheap determinism challenge against these doctrines to stand: tempering the modal arbitrariness challenge requires either spacetime points with sufficiently rich modal profiles, or enough quasi-points with a range of rich modal profiles, yet in securing these results the doctrines countenance objects at every time that encode too much information about the past and future, thereby plaguing the doctrines with cheap determinism. Yet demanding-modal-essences and plenitudinous substantivalism were the two remaining doctrines that might have enabled proponents of anti-haecceitism or no-shifts to avoid my modal arbitrariness challenge, each corresponding to one horn of my dilemma.

8 The Way Forward

The foregoing dialectic has been quite involved. Let's recap where we've been. My modal arbitrariness challenge for anti-haecceitism and no-shifts left proponents of these modal doctrines with a dilemma: super demanding modal essences or wholly arbitrary modal essences. The first horn faltered on the problem of cheap determinism. The second horn bifurcated as to where best to source the vagueness required to temper the threat of arbitrariness. We saw the first Lewis-inspired option of sourcing the vagueness in metaphys-

⁵⁸An analogous point could also be made using qualitative purely spatiotemporal properties, in particular those constructed out of qualitative fundamental spatiotemporal relations between quasi-points that are incompatible with coincidence, but I won't go through the details of this case here.

⁵⁹There is a large literature of attempts to single out certain foliations at possibilities where GR is true, for instance appealing to constant mean curvature. For any such attempt, we could imagine a restriction of unrestricted-plenitudinous-substantivalism or demanding-modal-essences that defines the near-sighted properties directly in terms of that foliation. The trouble is that all of these attempts are extremely complex and unnatural from the point of view of fundamental metaphysics, and so it's hard to get into a frame of mind where any enjoys some sort of metaphysical privilege. Moreover, the resulting restricted doctrines would fail to be well-defined at possibilities with laws unlike those of GR.

ical modality itself to be independently problematic. So we were left with the option of seeking a doctrine that sources the vagueness in the very notion of a spacetime point or region. Yet we saw every extant option of this kind also to be independently problematic, and hence to offer little solace to proponents of anti-haecceitism or no-shifts. So instead we developed a novel metaphysic of the relevant kind that avoids all of the problems for extant views, namely plenitudinous substantivalism. Yet this doctrine turned out also to be vulnerable to the problem of cheap determinism. The upshot of all of this is that the original modal arbitrariness challenge to anti-haecceitism and no-shifts stands.

The conclusion I draw is that we should reject the consensus position in the metaphysics of spacetime that supplements substantivalism with these modal doctrines. Now matters are slightly more complicated than this: recall from section 1 that although rescuing determinism from the hole argument has been the most prominent, and in my mind the most promising, means of defending the consensus position, other avenues of defense are available. So a more careful conclusion is that this traditional motivation for the consensus position fails. However, I think uncontroversially this upshot should incline us to dramatically lower our credence in the consensus position. Indeed, as noted above, in my mind the only compelling motivation for the consensus position stemmed from considerations of preserving determinism.

A moral of the foregoing is that *everyone* should regard the standard unrestricted definition of determinism as cheap and trivial. Haecceitist substantivalists, who eschew no-shifts, should accept that determinism is false on the cheap, independent of what the laws are like, because of the hole argument. For haecceitists we should be invested in rescuing determinism only in some restricted sense that is compatible with shifts: for instance, determinism only as concerns qualitative propositions (see the works cited in footnote 53 for discussion). By contrast, substantivalists who are anti-haecceitists or proponents of no-shifts should accept that determinism is true on the cheap, independent of what the laws are like, because of my modal arbitrariness challenge coupled with my challenge from cheap determinism. All of our best contemporary physical theories are field theories, which admit constructions like the hole argument. And we now see that in this setting the truth or falsity of determinism as standardly defined becomes predominantly a matter of armchair investigation, altogether divorced from questions of what the laws of nature are in fact like.

Where should those hoping to resuscitate the consensus position focus their energies moving forward in light of my results? I think the most promising tack lies in further investigation of the radical metaphysic of plenitudinous substantivalism that I've developed here, given the problems with its rivals that emerged in section 6.⁶⁰ The crucial

⁶⁰One embellishment of plenitudinous substantivalism worth investigating holds that no quasi-points figure in any fundamental facts; for instance, pairing the doctrine with the grounding-qualitativist doctrine, mentioned in section 3, according to which all haecceitistic facts (even those about particular quasi-points) are non-fundamental, obtaining wholly in virtue of qualitative facts. I regard this embellishment as the most

question will be whether one can address my cheap determinism challenge. My discussion left open that there's a restriction of plenitudinous substantivalism that renders the doctrine immune to cheap determinism, yet which avoids the issues that we saw with restricted-plenitudinous-substantivalism. However, it should come as no surprise given my arguments above that I'm not optimistic about the prospects of this avenue for further investigation.

My current view, then, is that the consensus position has for too long been uncritically adopted in the extant debate, and that we should instead embrace a haecceitist substantivalism. But more important than that conclusion, I take the various choice-points that I've investigated in defending the modal arbitrariness challenge to be where discussions in the metaphysics of spacetime should focus moving forward. Thus, no matter where the balance of considerations ultimately points, I'm confident that the modal arbitrariness challenge promises to significantly advance the current dialectical landscape.⁶¹

promising means of addressing two objections to plenitudinous substantivalism that I didn't discuss—that the plethora of quasi-points flout considerations of ontological parsimony, and that they fail to be freely modally recombinable—given that arguably these considerations at best matter only at the fundamental level. Of course it's an open question whether some ambitious grounding-qualitativist program can succeed, a question I'm inclined to answer in the negative. But embracing plenitudinous substantivalism, and hence more objects at a non-fundamental level, doesn't raise any new challenges for the program. Rather than discuss these issues, I've focussed on the challenge from cheap determinism, which I regard as the central stumbling block for plenitudinous substantivalism, and which would afflict even this embellishment of the doctrine.

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