Grim Reaper Paradoxes and Patchwork Principles: Severing the Case for Finitism

Benardete paradoxes involve infinite collections of Grim Reapers, assassins, demons, deafening peals, or even sentences. These paradoxes have recently been used in arguments for finitist metaphysical theses such as temporal finitism, causal finitism, and discrete views of time. Here we develop a new *finite* Benardete-like paradox. We then use this paradox to defend a companions in guilt argument that challenges recent applications of patchwork principles on behalf of the aforementioned finitist arguments. Finally, we develop another problem for those applications by examining the notion of exact duplication.

Key words: Finitism, Benardete Paradoxes, Patchwork Principle, Intrinsicality

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Imagine there's an infinite sequence of Grim Reapers spanning an infinite past. Each Reaper has a unique natural number and a designated date to post its selfie on the official Grim Grammers Instagram page. If no selfie has been posted by Reaper n's designated date, Reaper n posts its selfie. But if an earlier Reaper posted its selfie, Reaper n does nothing. Reaper 1's designated date is January 1st, 2024; Reaper 2's designated date is January 1st, 2023; and so on *ad infinitum*.

Clearly *some* Reaper must have posted its selfie. If, for example, no Reaper had posted its selfie up until the beginning of 2024, then Reaper 1 posted its selfie. But *which* Reaper posted its selfie? Reflection reveals that *none* of them could have posted it. If Reaper n posted its selfie, then Reaper $(n+1)$'s designated date already transpired without any earlier Reaper having posted its selfie, in which case Reaper $(n+1)$ posted its selfie. But then Reaper n didn't post its selfie, since Reaper n posts its selfie only if no earlier Reaper posts its selfie. So, there is no n such that Reaper n posted its selfie. In other words, no Reaper posted its selfie. And yet *some* Reaper must have posted its selfie!

This style of paradox dates back to Benardete (1964), and since its inception, many variants have blossomed. Ranging from Reapers to demons shouting 'yes' or 'no', there's something of a cottage industry at this point.[1] These paradoxes—hereafter, *Benardete paradoxes*—have also been used to justify various finitist metaphysical theses such as causal finitism, temporal finitism, and the discrete nature of time.[2]

Our primary goal is to criticize Benardete-paradox-based arguments for finitist theses—hereafter, *B-arguments*—and thereby to advance debates in metaphysics, philosophy of time, and even philosophy of religion.[3] In particular, we challenge a central motivation for the conditional premise of B-arguments that links the possibility of various infinities to the possibility of Benardete paradoxes. This motivation derives from *patchwork principles*. We begin in §1 by describing the structure of Benardete paradoxes and explaining how patchwork principles have been employed on behalf of B-argument linking premises. Then, in §2, we develop a companions in guilt argument based on a new *finite* Benardete-like paradox. Our argument challenges prominent uses of patchwork principles to support linking premises in B-arguments. Finally, in §3, we use a plausible principle about exact duplication to develop another problem for those patchwork-principle-based defenses of B-arguments.

1   Benardete paradoxes and B-arguments

Following Shackel (2005), Benardete paradoxes share a formal structure involving two jointly unsatisfiable conditions. Let an *unbegun set* be an infinite set, linearly ordered by the abstract relation *before* (*Bxy*), with no first member. Quantifying over the elements of an infinite set S linearly ordered by *before*, we can now state Shackel's (2005, p. 398) first condition:

Unbegun Condition (UC): $\forall x \exists y \, (Byx)$

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[1]See, e.g., Pruss (2018), Erasmus (2018), Cohen (2015), Koons (2014, 2020), Luna (2009a,b), Laraudogoitia (2003), Hawthorne (2000), Priest (1999), Sorensen (1998), and Yablo (1993b, 2000).

[2]Causal finitism says that necessarily, nothing has infinitely many causes. Temporal finitism says that infinite pasts are metaphysically impossible.

[3]B-arguments are relevant to philosophy of religion because they've been leveraged in support of a premise in the *Kalam cosmological argument*—see (*inter alia*) Pruss (2018, ch. 9), Koons (2014, 2020), and Erasmus (2018).

According to (UC), S has no first member—for any x in S, there's some y in S before x.

The second condition says that for each x in S, x satisfies some predicate E if and only if no member before x satisfies E. Quantifying over elements of S, we state Shackel's (2005, p. 398) second condition:

At iff Nowhere Before Condition (ANBC): $\forall x \, (Ex \leftrightarrow \neg \exists y \, (Ey \wedge Byx))$

As Shackel shows, these two purely formal conditions are logically inconsistent.[4] We might think this logical inconsistency is key to solving Benardete paradoxes: while (UC) and (ANBC) may be *individually* possible, their conjunction is simply inconsistent and hence impossible, *end of story*. However, finitists of various stripes have urged us to resist this deflationary solution by developing B-arguments for finitist theses. Here's the general form of B-arguments:

1. If there could be unbegun sets ordered by R, then there could be sets satisfying both (UC) and (ANBC). (*Linking premise*)

2. There cannot be sets satisfying both (UC) and (ANBC).

3. So, there cannot be unbegun sets ordered by R. (From 1, 2)

B-arguments for causal finitism fit this schema by replacing R with *causes*. B-arguments for temporal finitism replace R with *earlier than* and consider unbegun sets of equal temporal intervals. Other B-arguments roughly follow suit.[5]

Prominent tools for motivating B-argument linking premises are *patchwork* or *recombination principles*.[6] These principles trace back at least to Lewis (1983, pp. 76-77), but their Humean inspiration is unmistakable. As an example, consider the principle Koons (2020, pp. 5-6) adduces:

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[4]We set aside the objection that Shackel's abstract characterization of Benardete paradoxes leaves out important features thereof (e.g., causal dependence), since none of our points in subsequent sections turn on Shackel's characterization capturing every important feature of Benardete paradoxes.

[5]For B-arguments for causal finitism, see (*inter alia*) Pruss (2018, pp. 47-48), Koons (2020), Erasmus (2018), and Luna (2009a). For B-arguments for temporal finitism, see (*inter alia*) Koons (2014, 2020) and Luna (2009a).

[6]These are employed in Koons (2014, 2020) and Pruss (2018), *inter alia*. For criticisms of the use of patchwork principles on behalf of B-arguments, see Schmid (2024, forthcoming) and Schmid and Malpass (2023).

First, we assume that some particular, localized situation, S, is metaphysically possible (and so contained in some possible world w_1). Second, we assume that there is a second possible world w_2 with a spatiotemporal or causal structure that provides enough 'room' for S to be repeated κ [times] (where κ is a cardinal number, either finite or infinite). On these two assumptions, the patchwork principle licenses us to conclude that there is a third possible world, w_3, in which a situation intrinsically identical to S has been repeated κ times (in the arrangement corresponding to the structure of w_2). The picture is that w_2 provides the frame, w_1 the sample patch, and w_3 the completed quilt.

To justify B-argument linking premises with this principle, we simply need to show how a quilted or patched-together world (W_3) instantiating a Benardete paradox results from applying the principle to a framework world (W_2) and a sample-patch world (W_1) containing an individual, intrinsically specified sample patch. Now, if the past could be infinite, then there is a possible world W_2 with (say) infinitely many past days and so enough 'room' to accommodate a unique Grim Reaper (GR), together with a particle and plane, on each day of the infinite past. And an *individual* GR with the intrinsic power and disposition to create and place a particle in a plane iff no earlier GR creates and places a particle in the plane is surely contained in some possible sample-patch world W_1. Assuming the past could be infinite, we can then use the patchwork principle to infer the possibility of a world in which an unbegun set of GRs satisfies both (UC) and (ANBC). Since that is *not* possible, it follows that the past cannot be infinite. While the aforementioned recombinations and duplications used an infinite past as a framework, other frameworks have been used—e.g., continuous or dense temporal intervals, infinitely many connected causal nodes, and so on.

In what follows, we focus on a version of the patchwork principle articulated and defended in Koons (2014). There are three reasons for this focus. First, it is very similar to the above patchwork principle, and what we say about the former applies *mutatis mutandis* to the latter. Second, the principle in Koons (2014) has an admirably high degree of rigor and precision, which makes it a more fitting target for evaluation. Third, what we say about *Koons'* application of the patchwork principle in the context of

B-arguments applies *mutatis mutandis* to other prominent applications thereof (e.g., Pruss (2018)).[7]

2　Companions in guilt

Our concern will be one B-argument in particular—Koons' Grim Reaper Argument (GRA)—although, as noted above, our case will generalize to other prominent patchwork-principle-based defenses of B-arguments. In the GRA, there are four premises (*P1–P4*) that are argued to be jointly inconsistent with the assumption for reductio that a bounded and non-well-founded time sequence is possible (*H1*).[8] Drawing the premises from Koons (2014, pp. 256-260) and leaving out the premise about spacetime's arbitrary compressibility *P4* (since it's irrelevant to our ensuing discussion):

P1. Possible Grim Reaper. There is a possible world W and a region R such that R has a finite temporal duration d seconds, there is a Grim Reaper wholly contained within R, and throughout R the Grim Reaper has the power and disposition to create a particle and place it at a designated position d meters from the plane P if there is no Fred particle closer to the plane than d meters, and otherwise to maintain any Fred particle that is within d meters of the plane in its initial position.

P2. Infinitary Patchwork. If S is a countable series of possible worlds, and T a countable series of regions within those worlds such that T_i is part of W_i (for each i), and f is a metric and topology structure-preserving function from T into the set of spatiotemporal regions of world W such that no two values of f overlap, then there is a possible world W' and an isomorphism f' from the spatiotemporal regions of W to the spatiotemporal regions of W' such that the part of each world W_i within the region R_i exactly resembles the part of W' within region $f'(f(R_i))$.

P3. Intrinsicality of the Grim Reapers' Powers and Dispositions. The powers/dispositions ascribed to each Grim Reaper are properties intrinsic to that Reaper in its corresponding region and world.

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[7]We acknowledge that one might develop variants of the patchwork principle that refer to possible *causal* structures rather than possible *spacetime* structures, and it's not immediately obvious that our companions in guilt argument will challenge B-arguments for *causal* finitism that appeal to those variants. Alas, exploring this further is beyond the scope of our article.

[8]At least one other assumption is needed to generate the inconsistency. This will be discussed in §3.

Koons resolves the inconsistency by affirming $P_1 \wedge P_2 \wedge P_3 \wedge P_4$ and rejecting H_1. However, this is not the most plausible way to resolve the contradiction. Our companions in guilt argument for this conclusion runs as follows:

4. If $P_1 \wedge P_2 \wedge P_3$ is true, then $P_1{}^* \wedge P_2{}^* \wedge P_3{}^*$ is true.

5. $P_1{}^* \wedge P_2{}^* \wedge P_3{}^*$ is not true.

6. $P_1 \wedge P_2 \wedge P_3$ is not true. (From 4, 5)

The conclusion implies that Koons' preferred resolution of the inconsistency among $P_1 \wedge P_2 \wedge P_3 \wedge P_4 \wedge H_1$ is mistaken. The details of each premise, as well as the content of $P_1{}^*$–$P_3{}^*$, will be elaborated in this section. Here's the roadmap. We begin by introducing a new *finite* Benardete-like paradox in §2.1. We then use this paradox to motivate (4) and (5) in turn. Then, in §2.2, we address five worries for our companions in guilt argument.

2.1 A finite Benardete-like paradox

Our paradox involves light bulbs of a special sort, which we will call 'Bulbs' to distinguish them from ordinary light bulbs. Each Bulb can be in one of two mutually exclusive states, *ON* or *OFF*. A Bulb is able and disposed to be *ON* iff there's no Bulb to its left which is *ON* (and otherwise to be *OFF*). We define the *to the left of* relation as follows:

> *Definition:* A Bulb b_n is *to the left of* a Bulb b_m iff there is a sequence of Bulbs $b_n, b_{n+1}, \ldots, b_m$ such that for each Bulb b_i in that sequence, b_i is to the immediate left of b_{i+1}. A Bulb b_n is to the *immediate* left of a Bulb b_m iff the glass of b_n is touching the electrical contact of b_m.

Given the above specifications, a Bulb with no Bulbs to its left will be *ON*. For instance, a linear sequence of four Bulbs would appear as follows:
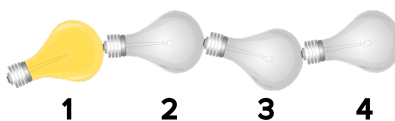

Figure 1: Four Bulb case (b_1–b_4)

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Notice that b_1 is *ON* because no Bulb to its left is *ON*, whereas each of b_2, b_3, and b_4 is *OFF* because some Bulb to its left is *ON*.

We can now provide *P1** as an analogue to *P1*:

> *P1*. Possible Bulb.* There is a possible world W and a region R such that there is a Bulb wholly contained within R, and throughout R, the Bulb has the power and disposition to be *ON* iff there is no Bulb to its left that's *ON*, and *OFF* otherwise.[9]

We will let *P2** be the same as *P2*, i.e., the Infinitary Patchwork principle. Finally, we provide *P3** as an analogue to *P3*:

> *P3*. Intrinsicality of the Bulbs' Powers and Dispositions.* The powers/dispositions ascribed to each Bulb are properties intrinsic to that Bulb in its corresponding region and world.[10]

We will now argue that if *P1*∧*P2*∧*P3* is true, then so too is *P1**∧*P2**∧*P3**. To do this, we will argue that if each individual *Pi* is true, then so too is the corresponding *Pi**.

First, why is *P1** true if *P1* is true? Well, like an individual GR, an individual Bulb *seems* possible; it is both conceivable and imaginable, and these are widely taken to be evidence possibility (cf. Yablo (1993a)); a Bulb is relevantly similar to lots of *actual* mechanical systems whose states are sensitive to things in their environment; its constitution is similar to *actual* light bulbs, which we know are possible; and so on. The modal epistemological supports wielded on behalf of a *GR's* individual possibility, in short, seem equally applicable to a *Bulb's* individual possibility. Metaphysically speaking, moreover, a Bulb—along with its

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[9] As described, a Bulb's disposition makes it potentially sensitive to the conditions in an infinite region (if, e.g., there are infinitely many Bulbs to its left). To avoid this implication, we could specify that a Bulb is disposed to be *ON* iff none of finitely many leftward Bulbs is *ON*, and *OFF* iff at least one of finitely many leftward Bulbs is *ON*. Since our paradox arises with finitely many Bulbs, this change affects neither our paradox nor the argument based on it. For simplicity, though, we'll use the simpler statement of a Bulb's disposition in *P1**.

[10] As Koons (2014, p. 263) notes, the inference to the possibility of a paradoxical patched-together world actually requires not only that a GR's *power/disposition* be intrinsic to it in its region and world but also that the *realization* thereof be intrinsic in this manner. Just as Koons makes this additional assumption in the context of *P3*, we can equally make it in the context of *P3**. Of course, we will challenge Koons' assumption here in §3, but our point is simply that *if* it's appropriate in the case of GRs, it's also appropriate in the case of Bulbs. Hereafter, we will treat this assumption as implicit in *P3**, making it explicit only when necessary.

specified power/disposition—is quite mundane. To bring this point out, imagine a world containing two such Bulbs. Suppose both Bulbs are *ON*. Now suppose that someone connects them such that one is to the immediate left of the other. In this case, the leftward Bulb would remain *ON* while the rightward Bulb would turn *OFF*. This is surely perfectly innocent. If anything, the Bulbs are *less* strange than their GR counterparts, which are capable of performing arbitrarily precise actions in arbitrarily small intervals of time. Bulbs seems quite tame in comparison. Thus, if we are granting the possibility of individual GRs, it seems we should grant the possibility of individual Bulbs. Consequently, if P_1 is true, then so too is P_1^*.

Second, P_2^* true if P_2 is true because P_2^* is the same assumption as P_2.

Third, P_3^* true if P_3 is true because the support provided for P_3 applies equally well to P_3^*. Each Bulb has the power to be *ON* or *OFF* under certain circumstances, and its having that power does not depend on anything else being arranged in a certain way. In the GR case, it was argued that "[e]ach GR has a power to produce a particle of a certain kind under certain circumstances. Its having that power does not depend on anything else being arranged in a certain way" (Koons ([2014](), p. 263)), and it seems fair to say the same here. The state of a Bulb simply varies with the circumstances according to the powers/dispositions we suppose it to have intrinsically. This is exactly parallel to what is assumed in the GR case: the state of a GR—say, creating a particle—varies with the environment according to the powers/dispositions we suppose it to have intrinsically. Consequently, if P_3 is true, then so is P_3^*.[11]

Having justified (4), we will now justify (5). Let's first introduce an assumption about possible space-times:

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[11]One might object that in the Bulb case, the relevant environment is *outside* a given Bulb's region, whereas in the GR case, the environment is *within* a given GR's region. This, in turn, makes a difference to whether the relevant power/disposition—or the *realization* thereof—is intrinsic to its bearer in the bearer's region. We have two replies. First, the Bulb power/disposition can be specified further to parallel the powers/dispositions in Koons' ([2014](), p. 264) Signaler variation. Just suppose that each Bulb has the intrinsic power/disposition to instantaneously transmit a signal rightward in the way described by (IC) in §[2.2.1](), such that the Bulb-regions adjoin in the same way that Signaler-regions adjoin (as described in Koons ([2014](), p. 264)). Given this specification, a Bulb need only act on a signal *in its own region*. Second, the GRA requires that whether a GR realizes its power/disposition *also* depends on what's happening in regions *outside* its own region, as we explain at the end of §[3]().

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H1*. Possibility of a Circular Spatial Arrangement. There is a possible world W containing a space-time region R consisting of sixteen spatially circularly-arranged non-overlapping Bulb-sized regions $R_1, \ldots, R_{16}$, such that for any $i \in \{1, \ldots, 16\}$, if R_i contains a Bulb b_i and R_{i+1} contains a Bulb b_{i+1}, then b_i is to the immediate left of b_{i+1}.[12]

We will now show that *P1*∧P2*∧P3*∧H1** is inconsistent. Since the Bulbs are possible individually (*P1**), clearly there are 16 worlds $W_1, \ldots, W_{16}$, each of which contains a region (R_1 at $W_1, \ldots, R_{16}$ at W_{16}) containing only one Bulb. Given *H1**, there is a possible region of spacetime (in some 'framework' world) that can accommodate the regions $R_1, \ldots, R_{16}$ in a spatially circular arrangement. The patchwork principle (*P2**) then licenses us to conclude that there is a possible world W' containing a region R' that consists of non-overlapping regions $R'_1, \ldots, R'_{16}$, the contents of which exactly resemble the contents of the corresponding regions $R_1, \ldots, R_{16}$, such that the regions $R'_1, \ldots, R'_{16}$ contain Bulbs that form a loop as depicted in Figure 2:
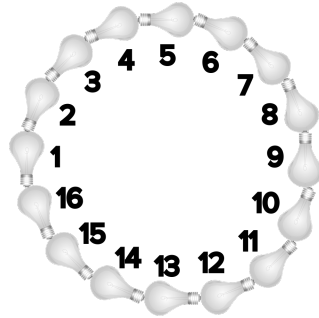

Figure 2: Loop of Bulbs at W'

Because the Bulbs' powers/dispositions (and realizations thereof) are intrinsic to them (*P3**) at their respective initial regions $R_1, \ldots, R_{16}$, and because the patchwork principle (*P2**) preserves intrinsic features, each Bulb will realize its power and disposition in the corresponding regions $R'_1, \ldots, R'_{16}$ at W'. But, alas, there's no way for this to be satisfied. Consider any Bulb b_i at W'. Since there is a sequence of Bulbs, $b_i, b_{i+1}, \ldots, b_i$ such that for each Bulb b_i in that sequence, b_i is to the immediate left of b_{i+1}, b_i is to the left of b_i. Therefore, every Bulb is to the left of itself. Suppose, then, that b_i is *ON*. Given that each Bulb realizes its power/disposition at W', any Bulb is *ON* only if each Bulb to its left is *OFF*. However,

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[12] Here, $i + 1$ is understood as $i + 1 \pmod{16}$, which ensures that $i + 1 = 1$ when $i = 16$.

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since b_i is to the left of itself, it follows that b_i is *ON* only if it is *OFF*. Hence, by assuming that b_i is *ON*, we conclude that it's both *ON* and *OFF*, which is absurd. So b_i is not *ON*. This reasoning is perfectly general, applying to *each* Bulb in R' at W'. Hence, no Bulb in R' at W' is *ON*.

But if no Bulb in R' at W' is *ON*, then no Bulb to the left of b_i in R' at W' is *ON*. Given that each Bulb realizes its power/disposition at W', any Bulb is *ON* if no Bulb to its left is *ON*. So, b_i is *ON* in R' at W'. Consequently, *some* Bulb in R' at W' is *ON*.

Thus, we have shown both that no Bulb is *ON* in R' at W', but also that some Bulb is *ON* in R' at W'—a contradiction. Hence, $P_1^* \wedge P_2^* \wedge P_3^* \wedge H_1^*$ is inconsistent. Since H_1^* is clearly true—*our world*, after all, contains such a region—(5) follows: $P_1^* \wedge P_2^* \wedge P_3^*$ is false.

Although it differs from Benardete paradoxes normally presented, our Bulb paradox has an abstract structure relevantly similar thereto (which is why we call it *Benardete-like*). The *to the left of* relation—while not a linear ordering relation—is analogous to the *before* relation, and any Bulb is *ON* iff no Bulb to its left is *ON*, giving us an analogue of (ANBC). Moreover, finitely many Bulbs connected in a circle ordered by the *to the left of* relation satisfy an analogue of (UC), as each Bulb is such that there is a Bulb to its left.

Here's the upshot. Having justified (4) and (5), we conclude that $P_1 \wedge P_2 \wedge P_3$ is not true. Hence, the GRA—which proceeds from the truth of $P_1 \wedge P_2 \wedge P_3 \wedge P_4$ to the falsity of H_1—fails. In what follows, we address five worries for our companions in guilt argument.

2.2 Worries

2.2.1 Worry One

Worry. Because the state of a Bulb instantaneously influences the states of any rightward Bulbs, P_1^* requires the possibility of instantaneous action at arbitrary distances. But then P_1 and P_1^* are not companions in guilt—or, at least, it is not true that if we accept P_1, then we should accept P_1^*. That's because P_1 requires no such dubious commitment. Moreover, since instantaneous action at a distance requires causal influence to transmit at infinite speed, P_1^* requires the possibility of infinite speeds. But this is

a controversial commitment. Huemer (2016), for instance, argues from a range of infinitary paradoxes to the theory that infinite natural intensive magnitudes are impossible, and speed of causal influence is plausibly a natural intensive magnitude. Once again, *P1* requires no such controversial commitment and faces no conflict with Huemer's theory.

Reply. From the fact that *P1* and *P1** require different commitments, the falsity of <if we accept *P1*, then we should accept *P1**> does not follow. What matters is whether their different commitments are *relevant* to their relative plausibility. So long as *P1**'s commitments don't make *P1** less plausible than *P1*, the epistemic parity between the premises remains: if *P1* is accepted, then *P1** should also be accepted.[13] The rest of our reply will unpack this general response.

Let's first note four ways of understanding the connection between Bulbs. Since these also correspond to different ways of understanding a Bulb's power/disposition to be *ON* iff no leftward Bulb is *ON*, we will note those too.

Indirect Causation (IC). A Bulb may indirectly affect the state of any rightward Bulb by propagating some information-carrying signal to it. Understood thusly, a Bulb is able and disposed to send such signals to any rightward Bulb and to be *ON* precisely when no signal from a leftward Bulb carries the information that a leftward Bulb is *ON*.

Direct Causation (DC). A Bulb may directly affect the state of any rightward Bulb without sending any intermediary information-carrier. Understood thusly, a Bulb *b* is able and disposed to directly

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[13]Of course, this *epistemic* parity is different from our conditional claim that if *P1* is true, then *P1** is true. Worry One only targets the epistemic parity, but the worry can be modified to target the conditional claim by saying that *P1** is (likely) false for reasons that do not afflict *P1* and that would not be assuaged by *P1*'s truth. These reasons pertain to the (alleged) impossibility of instantaneous action at a distance and infinite intensive natural magnitudes. We have three replies. First, the epistemic parity is itself grounds for accepting the conditional claim, since if *P1** is at least as plausible as *P1*, then we have reason to think that it's *false* that *P1*∧¬*P1** and hence that if *P1* is true then *P1** is true. Second, many of our ensuing responses address this modified worry because they directly address the claim that *P1** is (likely) false for those reasons. Third, we could easily formulate our companions in guilt argument in purely *epistemic* terms, thereby doing away with the conditional claim. In particular, we could simply argue that if someone accepts each of *P1*–*P3*, then they should also accept each of *P1**–*P3**. And that's true if *P1**–*P3** are at least as plausible as *P1*–*P3*.

cause any rightward Bulb to be *OFF* precisely when *b* is *ON* and to be *ON* precisely when no leftward Bulb directly causes *b* to be *OFF*.[14]

Metaphysical Determination (MD). A Bulb may metaphysically determine the state of any rightward Bulb (when the enabling condition of there being rightward Bulbs is met).[15] Understood thusly, a Bulb *b* is able and disposed to metaphysically determine any rightward Bulb to be *OFF* precisely when *b* is *ON* and to be *ON* precisely when no leftward Bulb metaphysically determines *b* to be *OFF*.

Bare Correlation (BC). A Bulb may simply correlate with other Bulbs in such a way that a Bulb is able and disposed to be *ON* iff no leftward Bulb is *ON*. The states of rightward Bulbs do not causally or metaphysically depend on (the states of) leftward Bulbs.

For each option, we will examine whether *Pi** is less plausible than *Pi* when Bulbs are understood accordingly. After proceeding through the options individually, we will also consider their *collective* impact on the parity between *Pi** and *Pi*.

Let *Pi**$_{(IC)}$ be *Pi** when the Bulbs are understood according to (IC). In our view, *Pi**$_{(IC)}$ and *Pi* are approximately equally plausible. For starters, many of the central motivations for *Pi* seem to carry over to *Pi**$_{(IC)}$. To us, GRs with the relevant power and disposition seem intuitively possible, and the same is true of Bulbs with (IC)'s power and disposition. GRs with the relevant power and disposition are perfectly consistent, and the same is true of Bulbs with (IC)'s power and disposition. GRs with the relevant power and disposition seem conceivable and imaginable, and the same is true of Bulbs with (IC)'s power and disposition. We can also motivate the possibility of infinite speeds by appealing to the principle that if x is possible and y differs from x merely in quantity or degree, then there is (defeasible) reason to think y is

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[14]We could modify (IC) and (DC) to fit your favorite theory of causal relata. For example, we could let the causes and effects be the events of Bulbs having certain states at certain times.

[15]As we use it, x metaphysically determines y when y depends on x *ontologically* (as opposed to *causally*). A paradigm metaphysical determination relation is *grounding*. Note that we can also modify (MD) to fit your favorite theory of the relata of metaphysical determination relations.

also possible.[16] If this principle is correct, then since finitely fast information-carrying signals like those in $Pr^*_{(IC)}$ are surely possible, there is (defeasible) reason to think infinitely fast information-carrying signals like those in $Pr^*_{(IC)}$ are possible too.

Of course, since speed of signal transmission is plausibly a natural intensive magnitude, $Pr^*_{(IC)}$ *does* run afoul of Huemer's theory. But in our estimation, this does not threaten the approximate parity between $Pr^*_{(IC)}$ and Pr. There are three reasons for this. First, Huemer's theory is meant to "account for which sorts of infinities are possible and which are impossible" (Huemer (2016, p. xiii)). But as Pruss (2018, pp. 153-159) and Schmid (2023) note, there are many infinitary paradoxes—including variants of paradoxes that Huemer's theory is meant to solve—that do not involve infinite natural intensive magnitudes. Moreover, because $Pr^*_{(IC)}$ entails the falsity of Huemer's theory, the abovementioned motivations for $Pr^*_{(IC)}$ are *themselves* grounds for rejecting Huemer's theory. These considerations make Huemer's theory quite unattractive to us.[17] Second, while $Pr^*_{(IC)}$'s denial of Huemer's theory is a controversial commitment that Pr does not share, Pr has various controversial commitments that $Pr^*_{(IC)}$ does not share. For instance, given the set-up of Koons' paradox, the GRs in Pr must be able to place particles at arbitrarily precise locations during arbitrarily short intervals of time, and it's controversial whether mechanisms could act arbitrarily precisely while moving at arbitrarily high speeds. If one sheds the commitment to arbitrarily high speeds by making the GRs ever-smaller by a geometric proportion, then Pr is saddled with a *different* controversial commitment—namely, the possibility of arbitrarily small material out of which GRs are made. These unique, controversial commitments of Pr do not seem more plausible to us than $Pr^*_{(IC)}$'s unique, controversial commitments. Third, B-arguments are often wielded on behalf of first-cause arguments for traditional theism. But as Huemer (2016, pp. 217-218) notes, his theory plausibly rules out traditional theism. At least in the current context, then, $Pr^*_{(IC)}$'s denial of Huemer's theory should not lead many defenders of Pr to deny the approximate parity between Pr and $Pr^*_{(IC)}$.

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[16] See Rasmussen (2014) and Pruss and Rasmussen (2018, ch. 6) for defenses of relevantly similar principles, and see Rasmussen (2018) for an application to infinite quantities and degrees. The guiding idea is that mere differences in degree don't typically make for a categorical difference in modal status. So, if x differs from y merely in degree and y is possible, then we have (defeasible) reason to think x is also possible.

[17] Pruss (2018, pp. 153-159) also argues (quite forcefully, in our view) that the theory suffers from a range of other problems.

Thus, we think $Pi^*_{(IC)}$ and Pi are approximately equally plausible. For similar reasons, we think the same holds for $Pi^*_{(DC)}$, which is Pi^* when the Bulbs are understood according to (DC). As before, the central motivations for Pi seem to carry over to $Pi^*_{(DC)}$: modal intuition, conceivability and imaginability, coherence, and so on. Moreover, Newtonian universes are often (and plausibly) taken to be at least *metaphysically* possible. Yet Newtonian gravity plausibly involves direct, instantaneous action at spatial distances.[18] Additionally, direct causation between *non-spatial* and spatial things is very plausibly possible— e.g., surely *some* possible world contains embodied organisms for whom non-epiphenomenalist dualism is true.[19] But there doesn't seem to be a relevant difference between this sort of direct causation and direct causation between spatially distant things that could account for why the former, but not the latter, is metaphysically possible. And while $Pi^*_{(DC)}$ uniquely and (somewhat) controversially commits to the possibility of direct causation across spatial distances, this commitment does not seem to us less plausible than Pi's unique and controversial commitments covered above.

Does $Pi^*_{(DC)}$ run afoul of Huemer's theory? It seems not. Given that $Pi^*_{(DC)}$ involves Bulbs directly inducing the states of other Bulbs, there is nothing that actually travels instantaneously between spatially distant Bulbs, and hence there is nothing that has infinite speed. And even if $Pi^*_{(DC)}$ *did* run afoul of Huemer's theory, this would not threaten the approximate parity between $Pi^*_{(DC)}$ and Pi for the reasons covered above.

Lastly, let $Pi^*_{(MD)}$ and $Pi^*_{(BC)}$ be Pi^* when the Bulbs are understood according to (MD) and (BC), respectively. Reactions may diverge concerning whether $Pi^*_{(MD)}$ and $Pi^*_{(BC)}$ inherit the motivations for Pi—e.g., whether $Pi^*_{(MD)}$ and $Pi^*_{(BC)}$ *seem* possible and whether they are conceivable. We can at least report positive answers from our end, but we recognize that others might report negative answers.[20] Finally,

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[18] A similar point applies to Pi^* more generally. Specifically, the Bohmian interpretation of quantum mechanics, as well as *any* of the handful of non-local interpretations, posit instantaneous action at arbitrary distances. At least *one* of these interpretations is plausibly metaphysically *possible*, and able philosophers have argued that non-locality is actually true (Maudlin (2011, p. 111)).

[19] Theistic proponents of B-arguments should grant this point, since God (traditionally conceived) is a non-spatial thing directly causally related to spatial things.

[20] Notably, it seems independently plausible that metaphysical determination relations can span spatial distances. To mod-

both $Pi^*_{(MD)}$ and $Pi^*_{(BC)}$ seem clearly consistent with Huemer's theory.

So far, we have only examined the four alternatives *individually* and concluded that at least two (and maybe all) of them do not make Pi^* less plausible than Pi on account of the commitments mentioned in Worry One. When we examine the alternatives *collectively*, the conclusion that Pi^* is not less plausible than Pi is only strengthened. After all, to justify the parity between Pi^* and Pi, we only need the more modest claim that the *disjunction* of $Pi^*_{(IC)}$, $Pi^*_{(DC)}$, $Pi^*_{(MD)}$, and $Pi^*_{(BC)}$ is not less plausible than Pi. And given our reasoning about the *individual* alternatives, we find this more modest claim very plausible.

Considering all the preceding, we think Worry One can be resisted. But before concluding, two final dialectical points are in order. First, suppose you find our replies to Worry One unconvincing. We then invite you to understand our case for the companionship between Pi and Pi^* as *conditional* on the possibility of instantaneous action at a distance. It is significant and philosophically interesting that our companions in guilt argument succeeds *if* instantaneous action at a distance is possible.

Second, even if instantaneous action at a distance is impossible, we can still develop a new finite Benardete-like paradox if closed timelike curves (CTCs) are metaphysically possible. For we can modify our Benardete-like paradox so that each Bulb has the intrinsic power/disposition to be *ON* iff no *earlier* Bulb is *ON* and *OFF* otherwise. We can then use a CTC as our spatiotemporal 'framework' into which we 'patch' (using $P2^*$) finitely many individually possible Bulbs with the newly modified power/disposition, such that the Bulbs are circularly arranged in time. Since each Bulb in the resulting patched-together world counts as earlier than itself, each Bulb is *ON* iff it is *OFF*.

Of course, one can avert this newly modified Benardete-like paradox by denying the possibility of CTCs. If this is how proponents of the GRA wish to resist our newly modified paradox, then we've at least uncovered a heretofore unnoticed commitment of the GRA—namely, the impossibility of CTCs. This is significant, since there's at least *some* independent reason to think CTCs are possible. They appear eminently conceivable; they might simply *strike* one as intuitively possible; and there are well-known, consistent solutions to Einstein's Field Equations which allow for them. To the extent that these consid-

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ify an example from Rosen (2017, p. 280), semantic content in one region is plausibly partly metaphysically determined by spatially distant dispositions and patterns of usage.

erations support the possibility of CTCs, they correspondingly count against the GRA.

2.2.2 Worry Two

Worry. The fact that $P_1{}^*{\wedge}P_2{}^*{\wedge}P_3{}^*$ is *unsatisfiable* given the obviously true $H_1{}^*$ while $P_1{\wedge}P_2{\wedge}P_3$ presumably *is* satisfiable given $H_1{}^*$ is *itself* a relevant difference between $P_1{\wedge}P_2{\wedge}P_3$ and $P_1{}^*{\wedge}P_2{}^*{\wedge}P_3{}^*$, and so we can reasonably reject $P_1{}^*{\wedge}P_2{}^*{\wedge}P_3{}^*$ without rejecting $P_1{\wedge}P_2{\wedge}P_3$.

Reply. This type of worry reflects a fundamental issue that arises in the context of companions in guilt arguments. The issue is the looming threat that *the very implausibility of one thesis* undermines its claimed companionship with the *other* thesis. The general way to proceed in light of this threat is to ask which is *more plausible* in light of the evidence: that (i) $P_1{\wedge}P_2{\wedge}P_3$ is true *despite* its apparent connection to the false $P_1{}^*{\wedge}P_2{}^*{\wedge}P_3{}^*$, or that (ii) $P_1{\wedge}P_2{\wedge}P_3$, *like* its seeming companion $P_1{}^*{\wedge}P_2{}^*{\wedge}P_3{}^*$, is false? Our arguments earlier in this section—offered in support of the conditional statements $P_1{\rightarrow}P_1{}^*$, $P_2{\rightarrow}P_2{}^*$, and $P_3{\rightarrow}P_3{}^*$—are precisely arguments that *directly support* (ii). In terms of comparing the relative plausibility of (i) and (ii), we side with (ii) being more plausible. But our case here is *defeasible*—in principle, it can be overturned by countervailing considerations. Such considerations could take two forms. First, one could undermine or rebut the arguments we gave that directly support (ii). Second, one could offer support for (i) that is *more* plausible than the support we offered for (ii). *Absent* such considerations, the conclusion we draw holds.

2.2.3 Worry Three

Worry. There is an additional assumption required by the circularly arranged Bulb case, namely, that infinite chains of dependence are metaphysically possible. For Bulb 1's state depends on Bulb 2's state, which depends on Bulb 3's state, which... depends on Bulb 1's state, which depends... *ad infinitum*. But if we deny that assumption and affirm dependence finitism—according to which such chains are metaphysically *impossible*—we can block the inference to the paradoxical Bulb scenario.

Reply. In the Bulb case, any Bulb's state depends only on *finitely* many things—namely, the states of the Bulbs in the scenario. In our view, then, dependence finitism is not violated.

But suppose the Bulb scenario *does* involve an infinite dependence chain (or any other allegedly absurd form of dependence). This is not a problem for our case, since such a chain is simply a *consequence* of $P_1{}^*{\land}P_2{}^*{\land}P_3{}^*{\land}H_1{}^*$, not an *additional* assumption that we might dismiss in order to preserve $P_1{}^*{\land}P_2{}^*{\land}P_3{}^*{\land}H_1{}^*$. Compare: in the GRA, H_1 is an assumption concerning possible spacetimes, an assumption that is later dismissed in order to preserve $P_1{\land}P_2{\land}P_3$. If it turned out that H_1 was a *consequence* of $P_1{\land}P_2{\land}P_3$, this move would not be available. Yet this is precisely what happens in the Bulb case. *Assuming* the Bulb scenario involves an infinite dependence chain, the possibility of such simply *follows* from $P_1{}^*{\land}P_2{}^*{\land}P_3{}^*{\land}H_1{}^*$. Thus, to *deny* that infinite dependence chains are possible requires denying $P_1{}^*{\land}P_2{}^*{\land}P_3{}^*{\land}H_1{}^*$. Since $H_1{}^*$ is true and $P_1{}^*{\land}P_2{}^*{\land}P_3{}^*$ is not less plausible than $P_1{\land}P_2{\land}P_3$, this would similarly undermine $P_1{\land}P_2{\land}P_3$—and with it, the GRA itself.

2.2.4   Worry Four

Worry. If Bulbs are possible, someone could attempt to arrange them into a circle (for example, as depicted in Figure 2), but since such an arrangement is not possible, there would have to be some mysterious force that prevents this construction. Such a mysterious force is absurd, and so $P_1{}^*$ is false. However, this problem does not equally attend P_1.

Reply. It is simply untrue that $P_1{}^*$ implies that there would have to be an absurd mysterious force preventing a seemingly mundane circular arrangement of Bulbs. Call a world containing Bulbs a 'Bulb world', and suppose that there are Bulb worlds at which someone or something attempts to arrange Bulbs into a circle as in Figure 2. One of three things might transpire in such a world:

7. Upon being arranged into a circle (or perhaps sometime before), at least one Bulb would fail to realize the relevant power or disposition or else lose the relevant power or disposition.

8. The attempt(s) to arrange the Bulbs into a circle would fail for some reason or other (e.g., the arranger slips on a banana peel, gets distracted, etc.).

9. Upon being arranged into a circle (or perhaps sometime before), at least one Bulb would cease to exist, with either (a) something qualitatively similar (e.g., an ordinary light bulb) continuing in its

place, (b) something qualitatively different continuing in its place, or (c) nothing continuing in its place.

So long as at least one of these options is metaphysically possible, no metaphysical impossibility follows from the possibility of Bulbs (at least as far as Worry Four is concerned). If this is right, then if there is *any* mysterious force here—which we deny—it's not *so* mysterious as to be impossible.

Let's consider the three options in turn. To us, the first alternative in (7) does not appear absurd at all. That some things reliably fail to realize their powers/dispositions in certain circumstances (even if they have those powers/dispositions intrinsically) is a perfectly ordinary phenomenon. A match, for instance, has the intrinsic power and disposition to light when struck, but the match may nevertheless reliably fail to light in sufficiently damp or wet environments. Similarly, for the second alternative in (7), it's a perfectly ordinary phenomenon that some things reliably lose powers/dispositions, even ones they intrinsically possess, in response to certain environmental conditions. In response to an acidic environment, for instance, blue litmus paper will reliably turn red and thus lose previously-possessed intrinsic powers/dispositions to reflect certain wavelengths of light.

Regarding (8), there is once more no absurdity here. To us, at least, there is nothing untoward in supposing that no one would succeed in circularly arranging Bulbs in a Bulb world. Further, no intolerably brute facts need be implicated in such a failure; in any Bulb world in which a circular arrangement is attempted, there is going to be an explanation for why the arranger fails to do so. It could be because they drop a Bulb, or do not line them up correctly, or slip on a banana peel, or any of countless possible reasons. This reply is similar to moves made in the context of time-travel paradoxes.[21] Tim the time-traveler will invariably fail to kill his grandfather, either because his gun jams, his grandfather survives the shot, or any number of things occur such that his grandfather survives. Again, while this might be *strange*, its strangeness provides no good reason to think time-travel is metaphysically impossible.[22] Similarly, although it may be that some of the worlds at which people attempt to combine Bulbs into loops involve

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[21]See, e.g., Lewis (1976) and Vihvelin (2020).

[22]In fact, as Baron and Colyvan (2019) have forcefully argued, we can offer a plausible and illuminating *non-causal* explanation for why Tim is doomed to fail by appeal to the *contradictoriness* of him succeeding. This explanation could be adapted to the present context *mutatis mutandis* for Bulb worlds in which the Bulbs realize their powers/dispositions. For an opposing

strange sequences of events, that strangeness provides no good reason to suppose that Bulbs are metaphysically impossible. Option (8), in other words, is not so strange as to debar Bulbs from the realm of metaphysical possibility.

Regarding (9a), consider the property of *being a planet*, where, necessarily, if something is a planet, then it orbits a star. If you destroy the star around which a planet is orbiting, there is no longer any planet present but merely some non-planet celestial body. There's nothing metaphysically suspicious about this. The proposal at hand is that whether some light bulb counts as a Bulb depends in part on its surroundings. Specifically, a light bulb ceases to be a Bulb if it finds itself in a circular arrangement of light bulbs, analogous to how a celestial body ceases to be a planet in the absence of stars. If Bulbs are like planets in this regard—and there seems to be nothing absurd in that assumption—then there is nothing absurd about (9). Because this scenario may result in the Bulbs' characteristic power/disposition being *extrinsic*, it may represent a case wherein $P1^*$ is true while $P3^*$ is false. The point, though, is that it doesn't seem to involve any intolerable absurdity.

One might object that our point in the previous paragraph undermines our claimed companionship between $P3^*$ and $P3$, since the point seems to provide grounds for thinking $P3^*$ is false *without* providing grounds for thinking $P3$ is false. We have two responses. First, even if this objection is correct, our points about (7), (8), and (9bc) remain unaffected and suffice to address Worry Four. Second, our point in the paragraph can be recast to remove any conflict with $P3^*$. Specifically, we can render a Bulb's characteristic power/disposition *intrinsic* by characterizing it as *essential* to Bulbs, where P is essential to x only if necessarily, if x exists, then x has P. Consider the definition of intrinsicality operative in the GRA (Koons (2014, p. 258)):

> A property P is *intrinsic* to a thing x within region R in world W if and only if x is P throughout R in W, and every counterpart of x in any region R' of world W' whose contents exactly duplicate the contents of R in W also has P throughout R'.

Given this definition, *any* essential property of x is intrinsic to x because there cannot be a region which

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view on grandfather paradoxes, see Loewenstein (2022). We don't find Loewenstein's case convincing, but that's a topic for another day.

contains a counterpart to *x* that lacks this property (assuming, of course, that the counterpart relation preserves essential properties).[23]

Regarding (9bc), while these kinds of occurrences might be strange, they are not for that reason *absurd*. Moreover, thinking (9bc) involves some intolerable absurdity seems unavailable to the proponent of the GRA, for it is *precisely* scenarios like this that should be possible given the patchwork principle. Consider two patches, one containing only a regular light bulb, and the second containing only a rock. By the patchwork principle, we can infer the possibility of a patched-together world at which these regions exist adjacently in time such that an outside observer would see what looks like a light bulb turning into a rock. If the patchwork principle is true, then occurrences like this are abundant in modal space. Why, then, would we rule out the possibility of Bulbs merely because (per options (9bc)) they would be implicated in scenarios of this sort? While more can be said on this point, it seems to us that the remaining options here are either to affirm the patchwork principle and affirm the possibility of these kinds of scenarios, or to deny the patchwork principle. The former does nothing to undermine our companions in guilt argument, while the latter directly undermines the GRA.

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[23]One might now question whether Bulbs that have their power/disposition essentially ('e-Bulbs' for short) are possible. After all, we cannot assume that objects with any arbitrary essence are possible. In response, we can at least report that <e-Bulbs are possible> doesn't seem much less plausible to us than <GRs are possible>, and much of the modal epistemological support for the latter can be wielded on behalf of the former. Moreover, many ordinary objects seem to enjoy environment-sensitive essential powers or dispositions—objects like planets, islands, and plateaus come to mind—and it's unclear what could account for why *these* are possible while e-Bulbs are not. It's also worth noting that there are respectable plenitudinous views on which any material object is co-located with multitudes of other material objects that differ in modal profile (see, *inter alia*, Bennett (2004) and Fairchild (2019, 2020)). Here, a *modal profile* is a specification of the modal properties of an object, where *modal properties* specify what an object is like essentially or accidentally. For any material object O, plenitudinous views of this sort will posit some object co-located with O enjoying all of O's non-modal properties, including O's dispositions, essentially. So long as such views are at least *possible* (and composible with the existence of Bulbs), the worry at hand is assuaged. Nevertheless, if you still find <e-Bulbs are possible> considerably less plausible than <GRs are possible>, just attend to our first reply in the main text.

2.2.5 Worry Five

Worry. Bulbs are impossible because any Bulb must have a disposition, when to the left of itself, to be *ON* iff it is not *ON*. But there cannot be such a disposition. Since this reason for rejecting *P1** does not apply to *P1*, there is no companionship between *P1** and *P1*.

Reply. We have three replies. First, we think there's a subtle but important mistake here. A Bulb b is disposed to be *ON* iff no Bulb to its left is *ON*. We can state b's disposition like so, where L is the transitive binary relation *to the left of*, Ox signifies that x is *ON*, and x ranges over Bulbs:

10. $Ob \leftrightarrow \forall x\,(Lxb \rightarrow \neg Ox)$

Now suppose:

11. Lbb

Importantly, it does not follow from (10) and (11) that:

12. $Ob \leftrightarrow \neg Ob$

For there is a (classical) countermodel to the argument from (10) and (11) to (12)—namely, a model with domain D: $\{b, b_1, b_2\}$ such that O: $\{b_2\}$ and L: $D \times D$.[24] But if (12) doesn't follow from (10) and (11), then merely from the fact that b satisfies (11) and has a disposition corresponding to (10), it doesn't follow that b has a disposition corresponding to (12). Thus, *contra* Worry Five, it is not true that a Bulb must have a disposition, when to the left of itself, to be *ON* iff it is not *ON*.

Second, we think a parallel argument can be run against *P1*: GRs are impossible because any GR must have a disposition, when preceded by a beginningless sequence of GRs, to act iff it does not act.[25] But given Worry Five, there cannot be such a disposition.

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[24]Of course, this model does not satisfy the biconditional that b_2 is *ON* iff no Bulb to b_2's left is *ON*, since b_2 is *ON* despite some Bulb to b_2's left (namely, b_2 itself) being *ON*. Hence, according to the model, b_2 either lost its disposition or failed to realize it. But we already saw in Worry Four that this is exactly how possible worlds containing circularly arranged Bulbs must be.

[25]To get a Benardete paradox, an individual GR must be disposed to act iff no earlier GR acts; if GR is preceded by a beginningless sequence of similarly disposed GRs, <GR acts iff no earlier GR acts> entails <GR acts iff it does not act>. Hence, GR having a disposition specified by the former biconditional requires that GR have a disposition, when preceded by a beginningless sequence of GRs, specified by the latter biconditional (which is a principle that Worry Five itself relies on).

One might object that there's a relevant difference between the arguments. GRs don't actually require the absurd disposition in the parallel argument, since a GR *cannot* be preceded by a beginningless sequence of GRs. And if scenario S cannot obtain, then it's *not* true that x is disposed, when S obtains, to ϕ.[26] But the same cannot be said of the original argument.

This objection grants that if Bulbs *cannot* be circularly arranged (so that a Bulb *cannot* be to the left of itself), then it's *not* true that a Bulb must be disposed, when to the left of itself, to be *ON* iff it is not *ON*. But notice that <Bulbs are possible> is perfectly compatible with <a Bulb cannot be to the left of itself>, and hence the possibility of Bulbs does *not* entail that a Bulb is disposed, when to the left of itself, to be *ON* iff it is not *ON*, *contra* Worry Five.[27] If one objects that if Bulbs *were* possible, then they *could* be circularly arranged, then we're back at (a variant of) Worry Four, which we've already addressed.[28]

Third, 'Bulb b has the disposition, when to the left of itself, to be *ON* iff it is not *ON*' is ambiguous between (i) *if* b is to the left of itself, *then* b has the disposition to be *ON* iff it is not *ON*, and (ii) b has a conditional disposition of the form: if it is to the left of itself, then it is *ON* iff it is not *ON*.[29]

Under disambiguation (i), the impossibility of b having a disposition to be *ON* iff it is not *ON* does not license us to infer that b is impossible; it only licenses us to infer that it is impossible that b is to the left of itself. It could be that b is possible even though it is not possible that b is to the left of itself.

Similarly, under disambiguation (ii), we cannot infer that b is impossible. Suppose it's not even possible that b is to the left of itself. Then the disposition in disambiguation (ii) is *not* a disposition to be in

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[26]Notably, Jenkins and Nolan (2012) challenge this principle by arguing that things can be disposed to ϕ in circumstances C even when ϕ and C are impossible. Their case might also undermine Worry Five's insistence on the absurdity of the characteristic Bulb disposition, but we won't explore that here.

[27]If P entails Q and R is compatible with P, then R does not entail $\neg Q$. After all, if R entails $\neg Q$ and P entails Q, then R and P are incompatible. Thus, if P and R *are* compatible and P entails Q, then R does *not* entail $\neg Q$. Now let P be <a Bulb cannot be to the left of itself>, Q be <it is not the case that a Bulb is disposed, when to the left of itself, to be *ON* iff it is not *ON*>, and R be <Bulbs are possible>.

[28]Note that granting the impossibility of circularly-arranged Bulbs would require abandoning option (7) concerning what might happen at Bulb worlds. But that doesn't seem particularly damaging to our companions in guilt argument. And in any case, our first reply to Worry Five allows for the possibility of circularly arranged Bulbs.

[29]Though, given our first reply, b need not have *either* of these dispositions.

a contradictory state *simpliciter*; it is only a *conditional* disposition to be in a contradictory state *if* some impossible situation obtains. But depending on one's view about counterpossible conditional dispositions (CCDs), either there is nothing absurd about that disposition, or else b would not even *have* that disposition.

Consider an analogous case. God (if God exists) is disposed to know p iff p is true (for any p). So, if we countenance CCDs, then we can attribute to God a CCD of the following form without absurdity: *if* some contradiction is true, then God knows that contradiction. By contrast, if we do *not* countenance CCDs, then we will simply deny that God *has* that CCD on the grounds that its antecedent is impossible. But that doesn't mean that God isn't disposed to know p iff p is true; God lacks the aforementioned CCD simply because its antecedent, though specifying that some p is true, isn't even possible in the first place.

The same can be said about Bulbs: for any world W at which b (with its characteristic disposition) exists, b at W is disposed to be *ON* iff every Bulb to its left is not *ON*. So, if we countenance CCDs, then we can attribute to b at W a CCD of the following form without absurdity: *if* it is to the left of itself, then it is *ON* iff it is not *ON*.[30] By contrast, if we do *not* countenance CCDs, then we will simply deny that b at W *has* that CCD on the grounds that its antecedent is impossible. But that doesn't mean that b at W isn't disposed to be *ON* iff every Bulb to its left is not *ON*; b at W lacks the aforementioned CCD simply because its antecedent, though specifying that b is to its left, isn't even possible in the first place given our earlier supposition. Either way, b at W does not have an absurd disposition—either because the disposition is not absurd, or because b at W does not have it.

So, on the assumption that b cannot be to the left of itself, b does not have an absurd disposition in any world in which b exists (with its characteristic disposition). But b's possible existence (with its characteristic disposition) is compatible with that assumption, and hence countenancing b's possible existence (with its characteristic disposition) does not mean countenancing the possibility that b has an absurd disposition, *contra* Worry Five.

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[30] Again, this doesn't actually follow, but Worry Five *needs* it to follow.

3   Exact duplication and Intrinsicality

We'll close by developing another problem for the GRA. We can state a GR's realized power/disposition (RPD) in general terms as follows:

> x has RPD $=_{def}$ x has the realized power/disposition to create and place a particle d meters away from a plane if and only if no particle has already been placed closer to the plane.[31]

As we've seen, the GRA requires that RPD is *intrinsic* to the GRs which have it. But this assumption is problematic. Consider an ostensibly uncontroversial patchwork inference, with just two sample-patch regions R_1 and R_2 from sample-patch worlds W_1 and W_2 (respectively). Suppose each region contains a GR, each of which has RPD intrinsically, and both of which are creating and placing a particle because they are initial in GR sequences at their respective sample-patch worlds. Given the obvious fact that there is a framework world W with enough spatiotemporal 'room' to fit two such GRs in sequence, we can use *P2* to infer that there is a possible world W' containing two regions in sequence, R'_1 before R'_2, the contents of which *exactly resemble or duplicate* the contents of R_1 and R_2 (respectively). All of this should be perfectly acceptable to proponents of the GRA.[32]

The problem, however, is that inconsistent conclusions can be drawn about the activities of the GRs at W'. First, the activity of the GR in R'_2 at W' should be *exactly the same* as the activity of the GR in R_2 at W_2, since *P2* ensures that the contents of R'_2 *exactly duplicate* the contents of R_2 (and similarly for R'_1 and R_1). Since both GRs are creating and placing a particle in R_1 and R_2, their counterparts in R'_1 and R'_2 will be doing exactly the same.

Second, the activity of the GR in R'_2 at W' should be *different* from the activity of the GR in R_2 at W_2. For the GR in R_2 has RPD intrinsically, and hence its duplicate GR counterpart in R'_2 at W' will likewise have RPD. But since the GR in R'_2 is *non-initial* in the sequence of GRs at W', a previous GR *will* have created and placed a particle closer than d meters to the plane. Since the GR in R'_2 has RPD,

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[31]The specifics of what value d takes, as stated in Koons (2014, pp. 256-257), are inessential here.

[32]This setup (and our ensuing problem) can easily be adapted to other versions of the GR scenario, be they ones with Fred, signals, or whatever.

this GR will then *refrain* from creating and placing a particle d meters from the plane. But then the GR in R_2' at W' will be doing something *different* from the GR in R_2 at W_2.

This is plainly inconsistent: the GR in R_2' at W' cannot both create and place a particle and *not* do so. We can summarize the assumptions which generate this inconsistency as follows:

13. Initial GRs are possible individually (from *P1*).

14. Infinitary Patchwork (*P2*).

15. Intrinsicality of GR's (realized) power/disposition (*P3*).

16. If (i) the contents of a region R_i' exactly duplicate the contents of a region R_i, (ii) R_i contains a GR$_i$, and (iii) GR$_i$ is creating and placing a particle in R_i, then some x is creating and placing a particle in R_i'.[33]

17. If R_i contains a GR that has RPD intrinsically, and the contents of R_i' exactly duplicate the contents of R_i, then R_i' contains an x that has RPD.[34]

The GRA clearly requires (13)-(15) and hence denying them to avert our problem is not an option for the proponent of the GRA. The GRA also requires (17), since if (17) is false, then it could be the case that each sample-patch region contains a GR that has RPD intrinsically even though *nothing* in the corresponding subregions at the patched-together world has RPD. In such a case, no Benardete paradox arises in the patched-together world.

Since (13)-(15) and (17) are needed for the GRA, the GRA proponent must reject (16). To us at least, this response strikes us as plainly *incorrect*—(16) is true, at least for any ordinary understanding of 'exact duplication'. If you were to examine two regions and notice that different things are happening inside those regions—e.g., a GR in one region is creating and placing a particle whereas *nothing* in the other region is creating and placing a particle—you would clearly be correct to conclude that the contents of those regions do not exactly duplicate each other.

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[33]Here, (16) does not require the stronger assumption x is a counterpart to GR$_i$, although that is a natural assumption. The weaker (16) suffices to generate the contradiction, and we followed Koons in (implicitly) making the stronger assumption in our earlier reasoning.

[34]Once again, (17) does not require that x is a counterpart to the GR in R_i.

Of course, one could also add an exact analogue of (16) to the assumptions about Bulbs in our companions in guilt argument to generate an exactly analogous contradiction.[35] Since (16) is incredibly plausible, this simply tells us that both the GRA and our companions in guilt argument share an underlying problem. This, of course, was the upshot of our companions in guilt argument, but we now have another path to the same conclusion.

We also think our problem in this section makes particularly salient which assumption is mistaken—namely, the assumption that the *realized powers/dispositions* of Bulbs and Reapers are intrinsic to them (P_3/P_3^*). Even if their characteristic *powers/dispositions* are intrinsic to Bulbs and GRs, whether those powers/dispositions are *realized* depends on the contents of other regions. Whether a Bulb b realizes its power/disposition to be *ON* iff no leftward Bulb is *ON* partly depends on the states of leftward Bulbs in other regions—if b is *ON*, then whether b realizes that power/disposition depends on whether some leftward Bulb (in a disjoint region) is *ON*. If a leftward Bulb is *ON*, then b has failed to realize that power/disposition (since b is *ON* despite some leftward Bulb being *ON*). For the same reason, whether a GR realizes its power/disposition to create and place a particle d meters from the plane iff no particle has been placed closer to the plane depends on the actions of previous GRs—if GR_i is creating and placing a particle d meters from the plane, then whether GR_i realizes that power/disposition depends on whether some previous GR (in a disjoint region) has placed a particle closer than d meters to the plane. If a previous GR *has* done so, then GR_i has failed to realize that power/disposition (since GR_i creates and places the particle despite a particle having been placed closer to the plane). Supposing otherwise enabled us to infer, absurdly, that an *initial* GR in a patched-together world could still *realize* its power/disposition despite failing to create and place a particle (even though no particle had been placed already).

One might object that the correct description of GR_i's power/disposition actually renders its realization *intrinsic*. The correct description is *not* that GR_i is able and disposed to place a particle d meters from the plane iff no particle has been placed closer to the plane by any previous GR. The realization of

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[35]For the same reason that the GRA needs (17), our companions in guilt argument likewise needs an exact analogue to (17). So, since our companions in guilt argument needs exact analogues of (13)-(15) and (17), adding an exact analogue of (16) will generate an exactly analogous contradiction.

that power/disposition *is* extrinsic to GR_i in its region. The *correct* description is that GR_i is able and disposed to place a particle d meters from the plane iff it does not find any particle closer to the plane (within its spacetime region). Whether *this* power/disposition is realized is a function purely of what happens inside GR_i's region; it does not depend on what happens in disjoint regions, and hence whether GR_i realizes its power/disposition is intrinsic to GR_i in its region.

But this objection fails. The GRA requires that whether GR_i finds a particle closer than d meters to the plane (within its region) *depends on* whether a previous GR created and placed a particle closer than d meters to the plane. This is precisely how Koons (2014, pp. 263-264) avoids the 'amazing vanishing particle' objection: the GRA requires that *some* sort of signal successfully transmits between GR-containing regions. In the case of GRs, this requires that the presence or absence of a particle in GR_i's region depends on whether there's another, earlier Reaper which created and placed the particle. Without this dependence assumption, it could be that *each* GR in the patched-together world creates and places a particle simply because none of the particles persist across the temporal boundaries of GR-containing regions—in which case, no Benardete paradox arises, as no set satisfies (*UC*) and (*ANBC*). So, the GRA requires that whether a particle is present in GR_i's spacetime region depends on what happens in disjoint regions. But whether GR_i realizes its power/disposition to place a particle d meters from the plane iff it does not find any particle closer to the plane (within its region) plainly depends on whether a particle is present in GR_i's spacetime region. So, given the transitivity of dependence, the GRA requires that whether GR_i realizes its power/disposition depends on what happens in disjoint regions, *contra* the objection at hand.

Finally, one might try to avert our problem in this section by modifying the patchwork principle. The modified principle would license us to infer only that the *realized intrinsic powers/dispositions* of the objects in sample-patch worlds, rather than *all* their intrinsic properties, are preserved in patched-together worlds.[36]

We have three brief replies. First, note that the modified principle must be strikingly fine-tuned. Specifically, it must license us to infer that *whether* a Reaper's intrinsic powers/dispositions are realized

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[36] If *all* powers/dispositions are preserved, including extrinsic ones, then familiar counterexamples to the patchwork principle will arise.

in a sample patch is preserved in the patched-together world, but it *cannot* license us to infer that the *way* in which they are realized (by, e.g., creating a placing a particle) is so preserved. (Otherwise, our problem simply re-arises.) But consider a correlative and almost-identical principle that *does* license the latter inference. We cannot see a principled, nonarbitrary way to accept the fine-tuned principle without accepting this correlative principle, and the motivations for the former seem to equally motivate the latter. Consequently, we think that anyone who accepts the former should accept the latter. And since the latter leads to our problem for the GRA, we do not think the suggestion at hand circumvents our problem.

Second, if the *way* in which a GR realizes its intrinsic power/disposition to create and place a particle iff no particle has been placed is by creating and placing a particle, then that GR *also* surely realizes its intrinsic power/disposition to create and place a particle (full stop). If this is right, then this modified patchwork principle would preserve *that* realized power/disposition as well, and so our problem remains: we can still patch together regions such that a GR creates and places a particle *despite being non-initial* in a GR-sequence.

Third, this objection doesn't avoid our challenge to *P3*, since the modified principle does not challenge our case for the conclusion that the GRA requires the *realization* of a GR's power/disposition to be extrinsic (and hence not preserved by patchwork principles). Yet the patchwork inference in the GRA *needs* to preserve the realization of GRs' powers/dispositions, since otherwise we cannot infer that the patched-together world instantiates a Benardete paradox.

For these reasons, we don't think the objection succeeds. Of course, further dialectical moves could be made, and we encourage future work to explore them in more detail.

4 Conclusion

We began by explaining Benardete paradoxes and B-arguments, which are arguments for finitist metaphysical theses based on those paradoxes. We also explained how patchwork principles are used to support the crucial linking premise in B-arguments. We then developed a new *finite* Benardete-like paradox involving Bulbs. In addition to being independently philosophically interesting, this paradox can be used

to defend a novel companions in guilt argument that challenges the GRA, an influential B-argument that relies on the patchwork principle. Finally, we developed another problem relating to *exact duplication* for the GRA. This problem, in turn, allowed us to pinpoint which assumption in the GRA is mistaken. While we think our arguments seriously undermine the GRA, our primary hope is that we have served and advanced debates surrounding Benardete paradoxes, finitism, B-arguments, and patchwork principles.[37]

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