

Benardete Paradoxes, Causal Finitism, and the Unsatisfiable Pair Diagnosis

Joseph C. Schmid
Princeton University

Alex Malpass
Independent Scholar

Abstract. We examine two competing solutions to Benardete paradoxes: causal finitism, according to which nothing can have infinitely many causes, and the unsatisfiable pair diagnosis (UPD), according to which such paradoxes are logically impossible and no metaphysical thesis need be adopted to avoid them. We argue that the UPD enjoys notable theoretical advantages over causal finitism. Causal finitists, however, have levelled two main objections to the UPD. First, they urge that the UPD requires positing a ‘mysterious force’ that prevents paradoxes from arising. Since such a force is implausible, the UPD is in trouble. Second, they employ *recombination* or *patchwork principles* to argue that paradoxical situations *would* be possible if causal finitism were false. Since such situations are *not* possible, causal finitism is true, and so a substantive metaphysical thesis *is* needed to avoid the paradoxes. We argue that the UPD proponent can successfully respond to these objections.

1 Introduction

Imagine there’s an infinite sequence of Reapers each with a designated time to kill Fred. If no Reaper kills Fred before Reaper n ’s designated time, Reaper n kills Fred at that time. But if an earlier Reaper *does* kill Fred before Reaper n ’s designated time, Reaper n does nothing. Reaper 1’s designated time is 60 seconds past 10:00; Reaper 2’s designated time is 30 seconds past 10:00; Reaper 3’s designated time is 15 seconds past 10:00; and so on *ad infinitum*. No Reaper’s designated time is at or before 10:00.

Clearly *some* Reaper kills Fred between 10:00 and 10:01, for if no Reaper kills Fred until 10:01, Reaper 1 does the deed at 10:01. Suppose Reaper n kills Fred. If so, then no Reaper before n kills Fred, since a Reaper kills Fred only if no earlier Reaper kills Fred. But then no Reaper before Reaper $(n+1)$ kills Fred, in which case—since a Reaper kills Fred if no earlier Reaper kills

Fred—Reaper ($n+1$) kills Fred. Hence, some Reaper before n kills Fred. So, if Reaper n kills Fred, then no Reaper before n kills Fred *and* some Reaper before n kills Fred. From this it follows that Reaper n does not kill Fred. Since this reasoning holds for any arbitrary n , no Reaper kills Fred. So, *no* Reaper kills Fred. But—as shown earlier—*some* Reaper kills Fred. Contradiction.

This is a *Benardete paradox*, named after its pioneer José Benardete (1964). Benardete himself developed different versions of the same underlying paradox involving deafening gongs, infinite firing squads, gods blocking someone’s path with impassable walls, etc. While the variants differ in certain respects, they all display the same logical structure (as we explain in §3). But why are Benardete paradoxes of metaphysical importance?

The reason is that *solutions* to Benardete paradoxes often involve substantive metaphysical theses. These solutions range from granting the contradictoriness of motion to ascribing irreducible causal powers to fusions to denying the possibility of infinite causal regresses. Another solution, however, promises to kill the paradoxes without incurring any significant metaphysical costs: the *unsatisfiable pair diagnosis (UPD)*. According to the UPD, Benardete paradoxes are best solved by simply recognizing that they uniformly involve two jointly unsatisfiable conditions. No substantive metaphysical thesis need be invoked—at least, not according to the UPD.

Defenders of alternative solutions have raised two main objections to the UPD, and we aim to show that the UPD proponent can successfully respond to these objections. We begin in §2 by surveying some of the metaphysically substantive solutions to Benardete paradoxes and highlighting their main deficiency. Then, in §3, we discuss the most promising metaphysically substantive solution: *causal finitism*. In §4, we discuss the UPD as an alternative, metaphysically lightweight solution to Benardete paradoxes. Finally, we address two main objections to the UPD: the mysterious force objection (§§ 5-6) and the patchwork objection (§§ 7-9).

2 Some metaphysically substantive solutions

There’s a small cottage industry of works discussing Benardete paradoxes, with new variations often created for illustration. This includes (*inter alia*) Yablo (1993b, 2000), Sorensen (1998), Priest (1999), Hawthorne (2000), Laraudogoitia (2003), Luna (2009a, 2009b), Koons (2014, 2020), Cohen (2015), Erasmus (2018), and Pruss (2018). This cottage industry is accompanied by a range of solutions to the paradoxes. For instance, Priest (1999, p. 2) thinks they show that motion produces a contradiction, while Hawthorne (2000) and Laraudogoitia (2003) think the underlying problem concerns whether fusions can have causal powers beyond the powers of their components.

An important problem for these solutions is that they are only *partial*. For example, Priest’s paradoxical variant involves an object sliding along a frictionless plane. But Pruss’ (2018, pp. 46-47) paradoxical variant—essentially the Reaper paradox presented at the outset of this article—doesn’t obviously involve motion like this at all. Conceding that motion is contradictory might address the variant that Priest considers, but it doesn’t seem to help with the Reaper variant. At best, then, Priest offers only a partial analysis, applying only to Benardete paradoxes where motion

is part of the set up. And as Shackel (2005, p. 403) points out, similar concerns about partiality apply to Hawthorne and Laraudogoitia's fusion analysis.

These partial approaches ask us to adopt quite substantive metaphysical claims, but the payoff doesn't seem worth it because other variants of the same underlying paradox remain unscathed. What we want is a *unified* solution that addresses *all* paradoxical variants in one fell swoop. If we have to give metaphysical ground, we want to get to the heart of Benardete paradoxes rather than peripheral aspects of only *some* variants thereof. Fortunately, there are two candidate unified solutions on the market, and we will consider each in turn.

3 Causal finitism

The first candidate unified solution is *causal finitism*, according to which necessarily, no effect has infinitely many causes (Pruss 2018, p. 2). Under causal finitism, then, infinite causal regresses are metaphysically impossible. Defenders of causal finitism as a solution to Benardete paradoxes include Pruss (2018), Erasmus (2018), Koons (2020), and Luna (2009b).

Causal finitists note that a common feature among Benardete paradoxes is the presence of infinite causal regresses. In the Reaper paradox, for instance, there's an infinite chain of ever-earlier reapers, and each Reaper's action depends causally on the actions of all the previous Reapers. The same holds for the deafening gongs, infinite firing squads, impassable walls, frictionless planes, etc.—in each paradoxical variant, we have infinitely many causes in a sequence with no first member. As Pruss (2018, p. 56) argues, the fact that causal finitism uniformly rules out Benardete paradoxes in one fell swoop is reason to suppose that it is true.

That, then, is the causal finitist solution to Benardete paradoxes. Before turning to the second candidate unified solution, some notes are in order about the hefty metaphysical commitments that causal finitism incurs. We discuss these because unified solutions to Benardete paradoxes with a *lighter* ontological cost are preferable (all else being equal) to those with a heavier ontological cost. As will become clear, the UPD carries significantly fewer ontological costs than causal finitism and is for that reason preferable (all else being equal).

The first ontological cost is that causal finitism constrains possible types of causation. For instance, it implies that causation *must* be discrete—necessarily, between some pairs of causes there is no further cause. Furthermore (and to state the obvious), causal finitism implies that both infinite causal regresses and infinite causal co-operation are impossible.

Another family of ontological costs concerns the structure of space and time. Consider Pruss' example of a falling object: "If an object is falling, it is plausible that for each past time *t* in its fall, the object's being where it was at *t*, with whatever velocity it had then, causes it to be where it is now" (2018, p. 167). If time were continuous (or simply dense), then this story would be a violation of causal finitism because the object's current location would be affected by infinitely many past causes. So, if causal finitism is true, then there can only be finitely many instants (or moments) of time in the fall of the object. Plausibly, then, if causal finitism is true, *time itself* is discrete. In fact, causal finitism plausibly implies that time is *necessarily* discrete. For, quite

plausibly, any world with continuous (or dense) time will contain causal processes each instantaneous stage of which affects later stages.

Of course, it's *conceptually* possible that time is continuous even though causation is discrete. Our point is simply that *given plausible auxiliary claims* about time and causation, continuous time would imply (the possibility of) continuous causation (and hence violations of causal finitism). One such auxiliary claim might be that if time is continuous, it should at least be *possible* for there to be causal processes each instantaneous stage of which is causally linked. Another might be that the structure of time depends on the structure of causation (together with the claim that, if this is so, time cannot be continuous whenever causation is discrete). Notice, too, that if the causal finitist wishes to *avert* the implication of discrete time, she must *deny* each such auxiliary claim, thereby incurring significant ontological costs and hence vindicating our central contention. It's also worth noting that physically respectable ways of merging continuous time with discrete causation involve *other* deeply controversial metaphysical commitments, which again vindicates our central contention that causal finitism has significant ontological costs. Moreover, the primary *motivations* for adopting causal finitism over the UPD equally motivate the discreteness of time. We will elaborate upon these points shortly.

Now consider the extent of past time. Plausibly, causal finitism implies that time is *necessarily finite towards the past*. As Pruss notes, "it is hard to see a plausible causal interpretation of a cosmology with an infinite past history that would not violate causal finitism" (2018, p. 180). Infinite pasts would plausibly involve infinite causal chains stretching back into the past—at minimum, successive stages of the universe itself (or parts thereof) would plausibly be connected by causal relations. Moreover, many of the same motivations for adopting causal finitism over the UPD—in particular, the two objections we consider later in the paper—would likewise favour adopting temporal finitism, according to which infinite pasts are impossible. As in his 2020 article, Koons (2014) employs the patchwork principle to deliver temporal finitism (as well as the impossibility of continuous temporal intervals). And if infinite pasts (or continuous time) were possible, one can argue that some absurd 'mysterious force' would be required to prevent (e.g.) infinitely many Reapers from acting in a paradoxical way throughout the infinite past (or a continuous temporal interval).¹ Causal finitism, then, plausibly leads to temporal finitism.

Consider next that the motivations for causal finitism seem equally to motivate the impossibility of infinitely large spatial regions. Take Erasmus' (2018) paradox involving an infinitely long line of Reapers in space. Each swings its scythe iff none of the infinitely many Reapers to its left swing their scythe. As with temporal finitism, we can wield the motivations for adopting causal finitism over the UPD to deliver the impossibility of infinitely large spatial regions. For instance, provided that some possible world has enough spatiotemporal 'room' to fit the relevant arrangement of spacetime regions, Koons' (2020) patchwork principle licenses us to infer the possibility of any arrangement of individually possible spacetime regions containing Reapers endowed with the intrinsic power and disposition to swing their scythe iff no leftward

¹ We're not here *endorsing* the mysterious force point but rather explaining that it would equally apply to the present context.

Reaper swings its scythe. Assuming there's a possible spacetime with infinitely large spatial regions, then some possible spacetime will be large enough to fit the aforementioned regions arranged such that each Reaper has an endless line of infinitely many Reapers to its left. Koons' patchwork principle then licenses us to infer that a world containing Reapers in such an arrangement is possible. But since such a world includes a spatial Benardete paradox, it is *not* possible, and hence our assumption that there's a possible spacetime with infinitely large spatial regions must be false. Likewise, if there could be infinitely large spatial regions, one can argue that some absurd 'mysterious forces' would be required to prevent (e.g.) infinitely many Reapers from acting in the relevant paradoxical way.

Similar points apply to continuous (and dense) spatial regions. Here's how the patchwork-principle-based motivation would go. Assume (for reductio) that continuous spatial regions are possible.² Then, quite plausibly, spacetime regions that contain ever-smaller Reapers that decrease in size (relative to each other) by a geometric proportion are *individually* possible.³ This seems like an innocuous assumption given that Koons' (2014) reductio of continuous time requires the possibility of Reapers that act in arbitrarily small temporal intervals. If Reapers like *that* are individually possible, then surely Reapers that get arbitrarily small in size are *likewise* individually possible.⁴ Now, given our assumption that continuous spatial regions are possible, some possible spacetime will have enough spatiotemporal 'room' and the right spatiotemporal structure to accommodate a finitely spatially large arrangement of infinitely many, ever-spatially-smaller, individually possible regions each containing a Reaper such that the Reapers are ever-smaller in the leftward direction (relative to the largest Reaper). The patchwork principle then implies the possibility of a spatially 'scrunched-up' version of Erasmus' spatial Benardete paradox.⁵ And once more, if there could be continuous spatial regions, one can argue that some absurd 'mysterious forces' would be required to prevent (e.g.) infinitely many ever-smaller Reapers from acting in a paradoxical way.

Thus, as with the extent and structure of time, causal finitism plausibly leads to the impossibility of infinitely large spatial regions and continuous space. In this way, causal finitism is not only a thesis about the structure of causation; it also leads to a far stronger program of 'spatiotemporal finitism' (for lack of a better term).

² The argument can also be made with *dense* spatial regions.

³ Indeed, this is plausible even if continuous spatial regions are impossible, since there doesn't seem to be any metaphysically necessary limit to how small the smallest units of space could be. Note that to run the patchwork-principle-based argument, the Reapers only need to be *individually* possible in the sense that each Reaper is contained in some world, *whether or not* there is some world that contains *all* the Reapers *together*. The latter is simply a *consequence* of applying the patchwork principle to the *individual* possibilities. Finally, note that we don't need *Reapers* specifically; we just need *some* mechanism with the intrinsic power and disposition to act iff no leftward mechanism acts.

⁴ And just as the former are conceivable and devoid of any evident contradiction or absurdity, so too are the latter.

⁵ Since Benardete paradoxes require a beginningless sequence (for some linear ordering relation), we'll have to ensure that no Reaper is to the left of the entire scrunched-up sequence of Reapers. But that's easy—just populate the rest of the world (using the patchwork principle) with individually possible regions containing things *other than Reapers*.

In fairness, Pruss (2018, ch. 8) considers whether causal finitism entails the discreteness of spacetime, and therein he shows fairly convincingly that it does not *directly* imply it.⁶ But this conclusion is not hugely helpful to the causal finitist in the present context. What Pruss shows is that there are some (at least logically possible) ways of interpreting physics such that, though causation is discrete, time itself is continuous. But this does not fundamentally change the point that causal finitism has substantial ontological costs; in fact, it only *reinforces* that point. As Pruss highlights, the causal finitist must take a stand on controversial issues in physics to avoid discrete spacetime. For instance, when discussing whether the notion of fields in physics is incompatible with causal finitism, Pruss concludes that “If causal finitism is true, then we have discrete space, or non-realism about fields, or causally inefficacious fields in empty space, or globalism about fields” (2018, p. 180). Any one of those disjuncts is a substantial implication, meaning that some meaty metaphysical consequence follows from causal finitism. Pruss does not contest our main point that causal finitism incurs quite hefty metaphysical commitments; he simply elaborates it.

These commitments don't merely saddle causal finitism with ontological costs; they also introduce tensions between causal finitism and various modal epistemological tools. For instance, conceivability is widely taken to be at least *evidence* of metaphysical possibility (cf. Yablo 1993a), whether or not it *entails* metaphysical possibility (cf. Chalmers 2010, ch. 6). And at least to us, various sorts of infinite pasts, infinite causal chains, continuous (or dense) temporal intervals, continuous (or dense) spatial regions, and infinite spatial regions appear eminently conceivable. What's more, if intuitions about metaphysical possibility provide defeasible reason to believe the contents of those intuitions, then if you (like us) find at least *some* of those spatiotemporal structures intuitively possible, you'll have defeasible reason to think causal finitism is false. Finally, consider the defeasible modal principle that if x is possible and y differs from x merely in quantity or degree, then y is possible (*ceteris paribus*).⁷ As causal finitists tend to grant, some finite past (or finite causal chain, or finitely large spatial region, etc.) is possible, and some infinite past (or infinite causal chain, or infinitely large spatial region, etc.) plausibly differs from some possible finite past merely in quantity or degree (of past time, or causal nodes, or spatial extent, etc.). If this is right, then once again we have defeasible reason to think causal finitism is false.⁸

None of this, of course, *refutes* causal finitism. But they're important considerations nonetheless, and we highlight them to contrast causal finitism with the second candidate unified solution to Benardete paradoxes. We will argue that the second solution incurs far fewer metaphysical commitments and does not run afoul of these modal epistemological tools. We will also argue that it is a more *unifying* solution to Benardete paradoxes than causal finitism. All of

⁶ Note, though, that he does not consider whether the *motivations* for adopting causal finitism as a solution to Benardete paradoxes would equally motivate the discreteness of space/time. And as we've explained, they plausibly do.

⁷ For nice defenses of this sort of principle, see Rasmussen (2014), Pruss and Rasmussen (2018, ch. 6), and Rasmussen (2018), the last of which extends the principle to infinite degreed differences.

⁸ One might also think that inclusion in physically live, empirically adequate models of the actual universe is defeasible evidence for metaphysical possibility. But *some* of the aforementioned spatiotemporal structures are included in physically live, empirically adequate models of the actual universe. (See, e.g., Linford 2022.)

this, in turn, provides strong reason to adopt that solution over causal finitism other things being equal.

4 The unsatisfiable pair diagnosis

The second candidate unified solution is Shackel's (2005) *unsatisfiable pair diagnosis*, which Pruss (2018, p. 48) calls the 'absurd conclusion objection'. The UPD is what Pruss (2018, p. 2) calls a 'conservative' analysis, as it does not postulate a revision in logic or any specific metaphysical thesis. It says that the paradoxical situations are simply (*narrowly*) *logically impossible, end of story*—no metaphysical thesis need be adopted. As Pruss puts it, the Reaper story is impossible "simply because an impossibility follows from it", and in particular, "the story would be impossible even if causal infinitism were true" (*ibid*, p. 48).⁹

Shackel observes that every Benardete paradox instantiates a schematic pair involving two jointly logically unsatisfiable conditions. Drawing from Shackel (2005, p. 401), these conditions can be stated as follows:

- A. The linearly ordered set S has no first member
- B. For all x in S, E at x iff E nowhere before x

It is a purely logical fact that A and B cannot both be true together. Shackel (2005, pp. 400-401) derives their formal inconsistency, but the outlines of the derivation should be clear from our earlier deduction of a contradiction from the Reaper story. Note that this logical inconsistency is entirely general: no classical relational model (i.e., no model of indexes where propositions are true, such as possible worlds, or times, etc.) is such that both A and B are true. Whenever we develop a Benardete paradox via some story containing A and B—for instance, a story about a man walking down a path with gods waiting to throw up impassable walls, or reapers waiting for their allotted time to kill Fred—we have expressed propositions that are not jointly logically consistent.

Shackel (*ibid*, p. 413) highlights that when presenting a Benardete paradox, often the initial set-up *appears* acceptable, and the contradiction is not immediately obvious. But it is plain that any story containing A and B is logically inconsistent nonetheless. The UPD proponent adds that, since contradictions are impossible, Benardete paradoxes are uniformly impossible. The UPD therefore promises a unifying solution to all Benardete paradoxes—each such paradox assumes that some set of items could satisfy both A and B. But no set can satisfy both A and B. Necessarily, any set satisfying one does not satisfy the other. For the UPD proponent, this alone suffices to kill Benardete paradoxes. Nothing more need be added.

The UPD proponent also does not accept that *if* A were possible, *then* (A&B) would be possible. If that conditional were true, then—since (A&B) is impossible—A would be individually impossible, and so fully addressing Benardete paradoxes would require a substantive metaphysical

⁹ *Causal infinitism* says that, possibly, some effect has infinitely many causes.

thesis (namely, ruling out beginningless sets of items linearly ordered by, e.g., the causal relation). But the UPD proponent does *not* think that fully addressing Benardete paradoxes requires a substantive metaphysical thesis, and hence the UPD proponent does not accept the aforementioned conditional.¹⁰

Metaphysically speaking, the UPD is substantially more lightweight than causal finitism. The causal finitist agrees with the UPD proponent that there cannot be true contradictions—this, after all, is why she thinks something has gone wrong with Benardete paradoxes—and yet the causal finitist *adds* that infinite causal regresses are impossible. The result is a commitment to a wide-ranging program of spatiotemporal finitism. The UPD requires nothing of the sort. Notice, too, that for precisely the same reason, the UPD does not conflict with the aforementioned modal epistemological tools. Unlike causal finitism, the UPD allows for the possibility of infinite causal chains, infinite pasts, continuous (and dense) space, continuous (and dense) time, and infinitely large spatial regions. Hence, modal epistemological supports for the latter do not count against the UPD in the way they count against causal finitism.

Finally, the UPD is a more *unifying* solution to Benardete paradoxes than causal finitism. For there are *non-causal* variants of Benardete paradoxes. Imagine, for instance, that instead of being *causally* sensitive to the actions of previous Reapers, each Reaper’s actions simply *brutely correlate* with those of past Reapers such that each Reaper satisfies the (purely truth-functional) biconditional embedded in the unsatisfiable pair. Causal finitism is powerless to kill *this* Benardete paradox, and so causal finitism cannot solve the full suite of Benardete paradoxes. But the UPD *can*, and this is a powerful reason to accept the latter solution over the former.¹¹

We will now address two main objections to the UPD. The objections, while probative, are not ultimately successful—or so we’ll argue.

5 The mysterious force objection

To set up the mysterious force objection, consider Yablo’s (2000) expression of an idea resembling the UPD. Yablo considers a Benardete paradox involving infinitely many demons each of whom wants to be the first to say ‘YES’, but would rather say ‘NO’ if another has said ‘YES’ already. Yablo notes that just because each demon’s intention seems possible to fulfil, the *totality* of them is not; just because *p* is possible, and *q* is possible, it doesn’t follow that (*p*&*q*) is possible. As he explains:

¹⁰ This, by the way, is where the two objections to the UPD in §5 and §7 come into play—each seeks to provide a reason to think that *if A* were possible, *then* (A&B) would be possible.

¹¹ Of course, causal finitism can always be *supplemented* with auxiliary hypotheses to kill non-causal variants. But this is to concede our point: causal finitism *alone* is not a unifying solution to Benardete paradoxes. *Further* controversial and metaphysically substantive theses are needed. Moreover, the resulting solution is an inelegant and disunified conjunction of seemingly unrelated metaphysical theses—for example, (i) causal finitism is true, *and* (ii) brute correlations between the intrinsic states of infinitely many entities is metaphysically impossible. And even *this* isn’t enough to kill all Benardete paradoxes because the intrinsic states of the entities might stand in some non-causal explanatory relation like grounding!

If we focus on any particular demon, there is nothing to stop her from executing her intention, given the opportunity. All she has to do is call YES iff her predecessors have called NO, otherwise NO. Does it follow that there is nothing to stop the demons from fulfilling their intentions as a group? Logic stops them. (*Ibid*, p. 150)

Yablo's talk of logic 'stopping' the demons from collectively fulfilling their intentions has drawn criticism, such as the following:

The problem is that logic is no causal force that could intervene as an overall ontological factor to stop the demons. To see how unlike any ontological factor logic is, just ask *exactly which demons are stopped by logic*, for there is no logical necessity that a particular group of them be. (Luna 2009b, p. 95)

Pruss makes a similar point. He contrasts the paradoxical Reaper story (with Reapers converging to 10:00 from the later-than direction) with a non-paradoxical *Reversed* Reaper story (with Reapers converging to 11:00 from the earlier-than direction). According to Pruss, the Reversed Reaper story should be possible if infinite causal chains are possible. And yet if the Reversed Reaper story is possible, then the paradoxical Reaper story should be possible, too. To suppose otherwise is to embrace an intolerably mysterious force preventing the paradox from arising. Here's how Pruss elaborates the argument:

[I]f the Reversed Grim Reaper story is possible... we should be able to additionally suppose an infinite number of tinkers with indeterministic free will adjusting the dials on the Grim Reapers around 9:30. ... [S]urely it would be *possible* for them to all set the dials to the settings in the original story. For *each* individual tinkerer could set the dial on *her* Grim Reaper to the setting that it would need to have in the original story. But since the tinkers are independent and indeterministically free, what other tinkers are doing doesn't affect what one of them can do. So there should be no difficulty about them *all* setting their Grim Reapers to the values needed for the original paradox. Otherwise, we have to suppose some strange metaphysical force preventing some settings. (2018, pp. 48-49)

The overarching point is that *if* condition A from the unsatisfiable pair *were* possible (where the beginningless set of items is linearly ordered by the causal relation), then the *conjunction* of conditions A and B would *also* be possible. To deny this conditional is to admit some intolerably mysterious force preventing B from being satisfied when A is satisfied. But since the conjunction of conditions A and B is *not* possible, we should infer that condition A is not possible. In other words, we should infer causal finitism—in which case, it's false that no substantive metaphysical thesis need be adopted to avert Benardete paradoxes, *contra* the UPD.

6 Euler to the rescue

We don't find this objection convincing, and we'll draw on an interesting recent paper by Baron and Colyvan to explain why. Consider Bridget trying to cross all seven bridges of Königsberg without crossing any bridge twice. As is well-known, Euler proved in 1735 that she cannot succeed. Now, in any given instance it might be that her failure to do so involves her accidentally doubling back on herself, or slipping on a banana skin and into the water, etc. But if we want to know why she is 'doomed to fail', rather than what happens on a given attempt, the explanation is not in terms of banana skins, but in terms of graph theory:

If we treat each of the seven bridges as an edge, and each of the land masses as vertices, the seven bridges can be treated as a connected graph. The resulting graph is non-Eulerian, which means that it provably lacks both an Eulerian path and an Eulerian circuit. An Eulerian path is just a continuous path through a graph that passes over each edge exactly once... The lack of Eulerian paths explains [why she is doomed to fail]: there just is no successful crossing available to Bridget so she *must* fail. (Baron and Colyvan 2019, p. 249)

As noted above, if Bridget attempts the task, then something will happen other than her succeeding. But once Euler's proof is understood, there is no need to resort to the assumption that a mysterious force intervenes. She will either get bored and give up, or slip on a banana skin, or unwittingly double back on herself, etc. But this is not because an invisible chaperone subtly influences her. Rather, it is a consequence of the fact that all the possible scenarios in which she attempts the task are logically consistent, and her succeeding is logically inconsistent (given Euler's proof). Nobody should think that her repeated failure to succeed requires an intolerably mysterious force preventing her success.

Our view is that precisely the same thing applies to Benardete paradoxes. Euler's formal proof of the mathematical impossibility of crossing all seven bridges without doubling back on oneself is akin to Shackel's formal proof of the logical impossibility of (A&B). And just as the mathematical impossibility of Bridget's success explains why she is doomed to fail without recourse to any mysterious force, the logical impossibility of a beginningless sequence of Reapers behaving in accord with condition B explains why they are doomed to fail in their attempts to behave that way without recourse to any mysterious force.

Sometimes the general failure of the infinitely many entities in Benardete paradoxes to collectively behave in accordance with condition B is explained by reference to individual instances of something going awry. Yablo writes, for instance, that "[n]ot all of the demons, then, can have stuck to the plan" (2000, p. 150). This might give the impression that Yablo is committed to some specific scenario, like some particular demon changing her mind about what she will do when her turn comes to speak. But we needn't be committed to any particular scenario, and we needn't specify *which exact demons* will fail. *Something* happens other than the demons collectively fulfilling their intentions, but nothing specific need be said about what would happen. A demon could slip on a banana skin when it was her turn to speak, or absent-mindedly forget her

allotted time, or repent of her demon ways and resign to a life serving God. Any number of mundane scenarios might play out. With Bridget's case, one does not need to specify what *would* happen if Bridget tries to cross all bridges without doubling back on herself. This is not Euler's burden of explanation, and nor is it Yablo's to say exactly what would happen with the demons. All he is saying—and all he needs to say—is that the demons jointly succeeding is logically inconsistent. And as with Bridget, no mysterious force need be waiting in the wings, ready to swoop in and prevent paradoxes from arising.

This point bears emphasis. In cases like this, we have found a given story to only describe logically inconsistent (and thus impossible) worlds. Asking *which exact demons (or tinkers)* would fail is like asking what is true in the closest possible world to a given logically impossible world. Yet we see no reason to assume that there *is* such a unique world (or well-defined set of such worlds). Maybe there are many roughly equally similar possible worlds, each involving things like banana skins, momentary losses of attention, etc., meaning the question has no unique answer. Or maybe there's an infinite sequence of ever-closer worlds, meaning the question has no answer at all. Or maybe the similarity metric is vague, or chaotically context sensitive. Behind the aforementioned question seems to be an implausible suggestion that we should be able to provide some unique specification of exactly which demons are 'stopped by logic'. If such a specific scenario were somehow identified as 'the one that would happen', the mysterious force objection might have bite. Something should explain why *that particular* accidental feature is bound to happen, and so we find ourselves reaching for a mysterious force. But UPD proponents can safely reject this suggestion. All they need to do is illustrate consistent stories that are somewhat nearby, like where demons change their mind, or where Bridget falls into the Pregel River, but nothing requires us to pick one as *the* thing that 'would happen'.

The Bridget example also sheds light on Pruss' rendition of the mysterious force objection. Imagine that seven of Yablo's demons are going to control Bridget's path across the bridges of Königsberg (numbered 1-7). Each demon is equipped with an indeterministic coin, and each coin flip is independent of the rest. Each demon, in turn, obeys a specific rule:

Demon #1's rule: Toss the coin. If it lands heads, then ensure that Bridget's path crosses bridge #1 and prevent Bridget from doubling back on bridge #1. If it lands tails, do nothing.

Demon #2's rule: Toss the coin. If it lands heads, then ensure that Bridget's path crosses bridge #2 and prevent Bridget from doubling back on bridge #2. If it lands tails, do nothing.

...

Demon #7's rule: Toss the coin. If it lands heads, then ensure that Bridget's path crosses

bridge #7 and prevent Bridget from doubling back on bridge #7. If it lands tails, do nothing.¹²

Assuming each demon follows her rule, *each* of the 128 permutations of coin flips will result in a perfectly mathematically consistent path *except one*: the permutation in which all coins land heads.¹³ But notice that we can echo Pruss' reasoning here. Surely it should be *possible* for all the coins to come up heads! Each *individual* coin could come up heads. But since the coins are independent and indeterministic, the result of *one* coin toss is not affected by the results of *other* coin tosses. So there should be no difficulty about them *all* landing heads. Otherwise, we have to suppose some strange metaphysical force preventing some coin flip results!

Clearly something has gone wrong, since it *cannot* be the case that all the coins land heads while the rules are obeyed. We think there are two available moves here, and either move equips the UPD proponent with a successful rejoinder to Pruss' mysterious force objection. First, one could grant that the scenario wherein the demons flip the coins and follow the rules is possible, but deny that it follows that all the coins in that scenario could (jointly) land heads. Even though the coin flips are all independent and indeterministic, not all permutations thereof are possible (simply because one such permutation would result in a mathematical impossibility). Naturally enough, this equips the UPD proponent with an equally plausible move in the case of Pruss' objection: the UPD proponent can grant that the Reaper story with tinkerers is possible, but deny that it follows that all the tinkerers could (jointly) set the dials in the paradoxical way (converging to 10:00 from the later-than direction, with no dial set to 10:00 or any previous time). Even though the tinkerers are all independent and indeterministic, not all permutations of their tinkering are possible (simply because some such permutations would result in a logical impossibility). So far, so good for the UPD.

Second, one could deny that the scenario wherein the demons flip the seven coins and follow those rules is possible. But why might that be? Quite plausibly, it's because the coins' independence and indeterminism *imply* that the coins *could* all land heads. That just follows from *what it is* for each indeterministic coin to be independent of the rest. But since the coins *cannot* all land heads given the rule-following, it cannot be the case that all the coins are independent and indeterministic while the rules are obeyed. Either some coin flip will depend on other coin flips, or some coin flip will fail to be indeterministic, or some rule will fail to be obeyed. But notice that the UPD proponent can then say the exact same thing in the case of the Reaper-tinkerer story. As with the demon-coin case, either some tinkerer's action will depend on other tinkerers' actions, or some action will fail to be indeterministic, or some Reaper will fail to obey the rule 'kill Fred iff no earlier Reaper kills Fred' at its designated time. If the causal finitist can take one of these routes

¹² To add even more indeterminism, we can suppose that each demon freely and indeterministically decides whether she'll toss her coin (and hence whether she'll follow her rule). We can suppose, too, that these decisions are all independent.

¹³ Note that it's possible to cross any arbitrary collection of *six* bridges of Königsberg without doubling back on oneself, and hence so long as *one* coin lands tails, the demons can all successfully follow the rules. Note, too, that each individual rule is perfectly possible to follow.

in the demon-coin case without admitting any intolerably mysterious forces, then the UPD proponent can equally take one in the Reaper-tinkerer story without admitting any intolerably mysterious forces.

Overall, then, we don't think the mysterious force objection should worry the UPD proponent.

7 The patchwork objection

Perhaps the patchwork objection will fare better. Proponents of this objection—e.g., Koons (2014; 2020) and Pruss (2018)—employ *recombination* or *patchwork principles* to argue that paradoxical situations *would* be possible if there *could* be infinite causal regresses (or infinite pasts).¹⁴ Since such situations are *not* possible, causal (or temporal) finitism is true. Thus, *contra* the UPD, a substantive metaphysical thesis *is* needed to avert Benardete paradoxes.

Koons (2014) offers the most rigorous defense of the patchwork objection, and we'll offer a streamlined explication of his defense before responding on behalf of the UPD.¹⁵ Koons begins by articulating an infinitary patchwork principle:

Infinitary Patchwork (PInf). 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 $f'(f(R_i))$. (*Ibid*, p. 258)

Here, 'exact resemblance' is understood as *exact duplication*, where exact duplicates share their intrinsic properties (*ibid*). In simpler terms, PInf says that so long as there's a possible world (our 'framework world') with enough spatiotemporal 'room' to accommodate (without overlap) an arbitrary arrangement of countably many individually possible spacetime regions (our 'sample patches'), then there's a possible world (the 'quilted world') containing exact intrinsic duplicates of those regions in precisely that arrangement.¹⁶

Here's how the patchwork objection proceeds. Assume (for reductio) that there's a possible world with an infinite past (containing infinitely many ever earlier temporal parts). Then there's a possible world with enough spatiotemporal 'room' to accommodate (without overlap) a beginningless arrangement of infinitely many non-overlapping spacetime regions containing

¹⁴ Patchwork principles trace back at least to Lewis (1983, pp. 76-77), but their Humean inspiration is manifest in their denial of necessary connections among distinct, intrinsically-typed existences.

¹⁵ Koons (2014) employs the patchwork principle on behalf of *temporal* finitism and extends the reasoning to *causal* finitism in Koons (2020).

¹⁶ Hereafter, 'spacetime region' refers to both the *containing region* and its *contents/occupants*. If regions aren't distinct from their contents/occupants, then this footnote is redundant. But that antecedent is controversial.

(exact intrinsic duplicates of) Reapers. Since spacetime regions containing Reapers with the intrinsic power and disposition to act iff no earlier Reaper acts are *individually* possible, PInf implies that some possible world *does* contain a beginningless arrangement of infinitely many Reapers, each of which is able and disposed to act iff no earlier Reaper acts. But since *that* would involve a Benardete paradox, *no* possible world contains such an arrangement. Contradiction. Hence, our assumption for reductio is false. No possible world contains an infinite past. Thus, *contra* the UPD, temporal finitism is needed to avert Benardete paradoxes.

How might the UPD proponent respond? They could appeal to extant responses to the patchwork objection based on (i) branching actualism (Schmid and Malpass 2023), (ii) the endless future parody (Schmid Forthcoming), (iii) the problem that patchwork principles fail to secure signal transmission in the quilted world (Schmid 2024), (iv) the companions in guilt argument with finite Benardete-like paradoxes (Dana and Schmid Forthcoming), or (v) the problem that the *realized* powers/dispositions of Reapers are actually extrinsic (Dana and Schmid Forthcoming). Here we will suggest a different (but perhaps complementary) response to the patchwork objection.

8 Provisos to the rescue

As Pruss (2018, p. 8) points out, unrestricted patchwork principles “carry many heavy metaphysical commitments.” Many of these metaphysical commitments are not only heavy but hard to swallow. For this reason, patchwork principles are usually restricted by including *provisos* therein. In this context, a *proviso* is a condition that needs to be met to license the inference to the possibility of the patched-together or quilted world by means of the patchwork principle. Lewis (1986, p. 89) famously added the proviso “size and shape permitting” to his patchwork principle, but many more provisos might be added besides.¹⁷ To motivate the need for provisos, we’ll below survey several heavy metaphysical commitments that PInf incurs.

Consider, first, that PInf plausibly entails the falsity of traditional theism. For there is clearly a possible world with billions of years of temporal ‘room’ and billions of light years of spatial ‘room’ sufficient to accommodate (without overlap) an arrangement of billions of individually possible spacetime regions each of which contains a conscious creature experiencing excruciating pain. Given PInf, it follows that there’s a possible world containing exact intrinsic duplicates of those regions in precisely that arrangement. But such a world includes vast amounts of horrendous, unredeemed, utterly gratuitous evil. In fact, we have populated this world *exclusively* with evils—*no* goods accrue from *any* of the instances of horrific suffering in the

¹⁷ Adding a proviso to PInf amounts to appending to end of PInf something like ‘...provided that such-and-such condition holds’. Note that an alternative way to avoid PInf’s controversial commitments is to make PInf *defeasible*, “with the understanding that it is best if defeaters... are principled rather than *ad hoc*” (Pruss 2018, p. 8). This doesn’t, however, affect our overarching argument in this section. Our argument, cast in terms of *provisos*, is that if the provisos we survey are acceptable, then so is an even *more* independently motivated proviso that debars Koons’ reductio. But our argument can equally be run in terms of *defeaters*: if the metaphysical commitments we survey constitute defeaters of the relevant applications of PInf, then so too will an even *more* principled commitment constitute a defeater of Koons’ crucial application of PInf. The two renderings of our argument are essentially identical. For simplicity, we’ll hereafter talk only of provisos.

quilted world. But such a world is surely incompatible with God's existence. Since such a world is possible (per PInf), it follows that God's non-existence is possible. But if traditional theism is true, God necessarily exists. Hence, traditional theism is false. Traditional theists, then, should reject PInf. And if they wish to accept a patchwork principle like PInf, a theism-friendly proviso needs to be added to PInf such as 'provided that the quilted world is compatible with God's existence' or 'provided that there's no God who would prevent the actualization of the quilted world'.¹⁸

Unrestricted patchwork principles also "rule out Aristotelian theories of laws and causation on which the exercises of causal powers necessitate their effects in the absence of counteracting causes" (*ibid*, p. 8).¹⁹ Consider a match. Under a broadly Aristotelian account of causal powers, the striking of a match (with appropriate speed and force, etc.) necessitates the lighting of the match in the absence of counteracting causes. Given PInf, however, the striking of the match (and any other process involving the exercise of spatiotemporal causal powers) does *not* necessitate its characteristic effect in the absence of counteracting causes. For there's a possible world with enough spatiotemporal room to accommodate an arrangement of individually possible non-overlapping adjacent spacetime regions R_1 and R_2 (where R_2 immediately temporally follows R_1), such that (i) R_1 includes both (a) the striking of a match against a matchbox (with the appropriate speed and force, etc.) up to (but not including) the moment the match lights and (b) the absence of causes that counteract match lightings, and (ii) R_2 includes the same match and matchbox (or counterparts thereof) in the absence of causes that counteract match lightings, such that the match's speed, position, etc. 'pick up where they left off' in R_1 but without lighting (perhaps because in the world from which R_2 is extracted, someone began the strike at the end of the striking surface).²⁰ *Contra* Aristotelianism, PInf delivers the possibility of a world containing precisely this arrangement of spacetime regions wherein a match strike fails to elicit its effect even in the absence of counteracting causes. Thus, Aristotelians should not accept the unrestricted PInf. Some Aristotelian-friendly proviso is needed.

Or consider another Aristotelian thesis incompatible with PInf: the natures (or identities) of concrete proper parts of substantial wholes (partly) depend on the parts' appropriate functional incorporation into their substantial wholes (Schaffer 2010, pp. 345–346). If this thesis is true, then those parts are not freely recombinable. Of course, the relevant *functional incorporation* is not intrinsic to those parts; but their *nature* (or *identity*) plausibly is, and that suffices for

¹⁸ Pruss (2018, p. 191) develops a similar case involving divine justice. Notice that conflict with theism is especially relevant to Koons' use of PInf, since Koons employs PInf in the context of the Kalam cosmological argument for theism.

¹⁹ Wilson (2010, pp. 609-611) makes a similar point. Note that Aristotelianism (or dispositional essentialism) isn't the only theory of laws that conflicts with PInf; *any* theory of laws that posits metaphysically necessary connections between the intrinsic characters of spatiotemporally non-overlapping properties, events, systems, entities, and/or regions do too (such as some versions of primitivism).

²⁰ While the absence of counteracting causes is plausibly extrinsic to the *match* in each region, it's *intrinsic* to each *region*, which contains not just the match but also any conditions relevant to counteracting the match's lighting. We can also populate the quilted world with *other* patches containing nothing with the power to counteract match lightings. (We're here assuming—in line with both Aristotelianism about powers and Koons (2014, p. 258) himself with respect to Reapers—that the match's and matchbox's powers are intrinsic to each.)

incompatibility with PInf.²¹ Note also that while a concrete proper part is not (typically) spatiotemporally disjoint from its substantial whole, it *is* typically spatiotemporally disjoint from *other* such parts of that whole. So long as the whole is essentially composed of multiple spatiotemporally disjoint concrete proper parts (as in, e.g., biological organisms), each (duplicate) of those parts cannot exist without another, spatiotemporally disjoint part (or duplicate thereof), *contra* PInf.

Lots of other metaphysical theses conflict with PInf, such as origin essentialism for individuals and biological kinds and the causal principle that beginnings require causes.²² At this point, though, the need for provisos needs no more belaboring. The central takeaway is the following. PInf conflicts with theism, Aristotelianism, the causal principle, origin essentialism, and many more views besides. To the extent that these views are independently motivated—and to the extent that we want to preserve a patchwork principle like PInf—we should include provisos in PInf that are friendly to such views.

But if the provisos surveyed above are included, then so too, we maintain, should a new proviso: ‘...provided that those regions being in that arrangement isn’t logically inconsistent (i.e., provided that no formal contradiction can be derived from those regions being in that arrangement)’. When added to PInf, we get a revised PInf or *RPInf* for short: so long as there’s a possible world with enough spatiotemporal ‘room’ to accommodate (without overlap) an arrangement of countably many individually possible spacetime regions, then—provided that those regions being in that arrangement is not logically inconsistent—there’s a possible world containing exact intrinsic duplicates of those regions in precisely that arrangement. By our lights, the proviso here is perfectly independently motivated: a logically inconsistent arrangement of regions violates the law of non-contradiction, which—given its intuitive obviousness—we have very strong reason to accept.²³ Indeed, we venture that the law of non-contradiction is *more* plausible and independently motivated than the proviso-inspiring views surveyed above. We therefore have even *stronger* reason to include our new proviso in a suitably restricted patchwork principle. Thus, if the provisos surveyed above are included, then so too should our new proviso be included. And since most causal finitists deploy causal finitism in arguments for theism—and since theism requires PInf to include a theism-friendly proviso—most causal finitists should grant our new proviso.

The trouble, though, is that the principle that results from our proviso, *RPInf*, doesn’t license Koons’ patchwork inference to the possibility of a quilted world involving a Benardete paradox. For the relevant arrangement of regions is logically inconsistent—it involves a beginningless sequence of Reapers each of which acts iff no earlier Reaper acts, which—as we’ve seen—logically entails a contradiction. Since that patchwork inference is needed for Koons’

²¹ Notably, so long as the counterpart relation preserves essential properties, *any* essential property turns out to be intrinsic given Koons’ (2014, p. 258) definition of intrinsicality.

²² Koons (2014, pp. 266-267) notes the conflict between the causal principle and PInf. He offers two options in response. First, one could concede the possibility of uncaused beginnings and thus deny the causal principle’s necessary truth. Second, one could add a causal-principle-friendly proviso to PInf.

²³ Following our causal finitist interlocutors, we’re setting paraconsistent views aside here.

reductio of the possibility of an infinite past, Koons' reductio thereof is blocked. This, in turn, blocks the inference to temporal finitism and therefore defeats the patchwork objection to the UPD.

To sum up, PInf incurs several controversial metaphysical commitments, including a denial of something causal finitists often seek to establish. To avoid these commitments, various provisos should be added to PInf. But if those provisos should be added to PInf, then so should our new consistency-respecting proviso. And if our consistency-respecting proviso is added to PInf (resulting in RPIInf), Koons' reductio of the possibility of an infinite past is blocked. And if that reductio is blocked, then the patchwork objection to the UPD fails.

We've just offered a positive argument for adding our consistency-respecting proviso to PInf. But we could also make our point as an *undercutting defeater*. In particular, we've been given no reason *not* to add our consistency-respecting proviso to PInf, and yet *not* adding our proviso thereto is required for the success of the patchwork objection. At the very least, then, we've uncovered an assumption underlying the patchwork objection—namely, that our consistency-respecting proviso should *not* be added to PInf—for which no justification has been offered. To the extent that the proviso's addition is an epistemically live option, the patchwork objection is undercut.

In the next section, we address two objections we've received to our reply to the patchwork objection. We also develop another positive argument for our consistency-respecting proviso.

9 Two objections and another argument

The first objection is that our consistency-respecting proviso absurdly disallows the use of the patchwork principle (in this case, RPIInf) in reductios. For if the patchwork principle only works in cases where the relevant arrangement is consistent, then we cannot employ the patchwork principle to derive any contradictions. But surely patchwork principles should be available for reductios!

This objection, however, misunderstands our proviso. Recall RPIInf: so long as there's a possible world with enough spatiotemporal 'room' to accommodate (without overlap) an arrangement of countably many individually possible spacetime regions, then—provided that those regions being in that arrangement is not logically inconsistent—there's a possible world containing exact intrinsic duplicates of those regions in precisely that arrangement. This principle can easily be used to perform a reductio so long as the reductio's contradiction is not formally derivable simply from the relevant arrangement of individually possible regions. To illustrate, my laptop currently sits atop a desk. To the laptop's right sits a glass of water, and to the laptop's left sits a pencil. Suppose Bridget says it's metaphysically impossible for the glass and pencil to have swapped places. We can easily use RPIInf to perform a reductio of Bridget's claim. There's obviously a possible world—our world, say—with enough spatiotemporal 'room' to accommodate (without overlap) an arrangement of individually possible regions containing my room, my desk, that glass of water, that pencil, and my laptop (respectively) such that the laptop sits atop the desk with the pencil to its right and the glass to its left. And there's nothing logically inconsistent about

that arrangement—clearly, no contradiction is derivable from there being a laptop to the right of which is a pencil and to the left of which is a glass. By RPIInf, there’s a possible world that exactly resembles this arrangement—and *that* contradicts Bridget’s claim. Supposing Bridget’s claim is true thus leads (by way of RPIInf and other obvious claims) to a contradiction. By reductio, Bridget’s claim is false. This also illustrates that RPIInf preserves our ordinary modal knowledge and recombinatorial reasoning.

In fact, notice that philosophically interesting reductios can be performed using RPIInf (or any patchwork principle including a consistency-respecting proviso). Consider Segal’s (2015, pp. 286–292) reductios of the assumption that causal relations are intrinsic to sequences of events (given a Lewisian patchwork principle). Segal supposes (for reductio) that causal relations are intrinsic to sequences of events, from which—together with the patchwork principle—he derives the possibility of arrangements of regions that involve either causal loops or failures of causal transitivity. Since the latter are taken to be absurd, Segal concludes that causal relations are extrinsic to sequences of events if the patchwork principle is true. Notice that these absurd arrangements, while perhaps *metaphysically* (or *broadly logically*) impossible, are not (*narrowly*) *logically inconsistent*. Consistency-respecting provisos therefore allow for philosophically interesting reductios.

But perhaps the idea behind the objection is that RPIInf-using reductios cannot be performed *when the relevant arrangement* is logically inconsistent. This, of course, is true. But, first, why is that problematic? As far as we can see, there’s nothing absurd or implausible here. Second, notice that a world containing a logically inconsistent arrangement is inconsistent with *any* condition that a proviso may require the quilted world to respect. Thus, *any* revision of PInf whose proviso requires the quilted world to respect some condition (whether theism-friendly, Aristotelian-friendly, or whatever) debar the inference to the possibility of a quilted world containing a logically inconsistent arrangement.²⁴ Since (i) PInf plausibly requires *some* proviso(s) requiring quilted worlds to respect certain conditions (as we argued earlier), (ii) adding any such proviso disallows the inference to the possibility of a quilted world containing a logically inconsistent arrangement, and (iii) disallowing this inference prevents the use of reductios employing (the suitably revised) PInf *when the relevant arrangement* is logically inconsistent, it follows that (iv) *if* this sort of reductio-prevention is problematic, *PInf itself* is problematic. The objection at hand, then, would only spell disaster for Koons’ case by impugning PInf. Our point in this paragraph also amounts to a second argument for the consistency-respecting proviso, since it shows that *any* proviso requiring the quilted world to respect some condition *implies* the consistency-respecting proviso. Consequently, if (as we’ve argued) we should accept a proviso of the former kind, then we should also accept the consistency-respecting proviso.

²⁴ This point is especially vivid in the case of theistic provisos, since God (*qua* perfectly rational) would not allow a logically inconsistent arrangement of spacetime regions to obtain. Thus, theistic provisos would likewise prevent the use of reductios when the relevant arrangement is logically inconsistent. And since Koons is committed to a theistic proviso (in virtue of wielding PInf in an argument for theism), Koons must grant that preventing these sorts of reductios is not problematic.

So much, then, for the first objection and our second argument for the consistency-respecting proviso. The second objection is that our consistency-respecting proviso begs the question against Koons, since the proviso precludes from the get-go precisely the sort of reductio Koons employs to establish the impossibility of infinite pasts.

This objection, however, is mistaken, as we offered *reasons* for including our proviso. We first motivated the need for provisos, after which we argued that if those provisos should be included in PInf, then so should ours. We thus gave *arguments* for the inclusion of our proviso. As a *consequence*, Koons' reductio of the possibility of an infinite past fails. But we did not merely *peremptorily stipulate* that the reductio fails. And even if our two positive arguments fail, we can still *undercut* the patchwork objection (as explained at the end of §8). Finally, even if our undercutting defeater fails, we've nevertheless highlighted several significant results in this section, such as that PInf—as stated—conflicts with the very theism it's often used to support.

In light of all the preceding, we conclude that the patchwork objection should not worry the UPD proponent.

10 Conclusion

Benardete paradoxes come in many different forms, and two solutions promise to kill them all: causal finitism and the UPD. We argued that causal finitism suffers notable theoretical costs compared to the UPD, making the latter preferable (at least *ceteris paribus*). These theoretical costs involve bloated ontological commitments, conflict with several modal epistemological tools, and the failure to be a *unified* solution to Benardete paradoxes. We then argued that the UPD proponent can successfully respond to the two main objections facing their view: the mysterious force objection and the patchwork objection. In our view, the UPD is an attractive solution to Benardete paradoxes. Whether we should adopt it over causal finitism *all things considered* is a question for another day. Nevertheless, we hope that our article plays an important role in that broader assessment.

References

- Baron, S. and Colyvan, M. 2019. The End of Mystery. *American Philosophical Quarterly* 56: 247-264.
- Benardete, J. 1964. *Infinity: An Essay in Metaphysics*. Clarendon Press.
- Chalmers, D. 2010. *The Character of Consciousness*. Oxford University Press.
- Cohen, Y. 2015. Endless Future: A Persistent Thorn in the Kalām Cosmological Argument. *Philosophical Papers* 44: 165-187.
- Dana, T. and Schmid, J.C. Forthcoming. Grim Reaper Paradoxes and Patchwork Principles: Severing the Case for Finitism. *The Journal of Philosophy*.

- Erasmus, J. 2018. *The Kalam Cosmological Argument: A Reassessment*. Springer.
- Hawthorne, J. 2000. Before-effect and Zeno causality. *Noûs* 34: 622-633.
- Koons, R.C. 2014. A New Kalam Argument: Revenge of the Grim Reaper. *Noûs* 48: 256-267.
- Koons, R.C. 2020. Does the Universe Have a Cause? In M. Peterson and R. Van Arragon (eds.), *Contemporary Debates in Philosophy of Religion (2nd ed.)*, 3-12. Wiley-Blackwell.
- Laraudogoitia, J.P. 2003. A Variant of Benardete's Paradox. *Analysis* 63: 124-131.
- Lewis, D.K. 1983. *Philosophical Papers*. Oxford University Press.
- Lewis, D.K. 1986. *On the Plurality of Worlds*. Wiley-Blackwell.
- Linford, D.J. 2022. Big bounce or double bang? A reply to Craig and Sinclair on the interpretation of bounce cosmologies. *Erkenntnis* 87: 1849-1871.
- Luna, L. 2009a. Yablo's Paradox and Beginningless Time. *Disputatio* 3: 89-96.
- Luna, L. 2009b. Ungrounded Causal Chains and Beginningless Time. *Logic and Logical Philosophy* 18: 297-307.
- Priest, G. 1999. On a version of one of Zeno's paradoxes. *Analysis* 59: 1-2.
- Pruss, A.R. 2018. *Infinity, Causation, and Paradox*. Oxford University Press.
- Pruss, A.R. and Rasmussen, J.L. 2018. *Necessary Existence*. Oxford University Press.
- Rasmussen, J.L. 2014. Continuity as a guide to possibility. *Australasian Journal of Philosophy* 92: 525-538.
- Rasmussen, J.L. 2018. Plantinga. In G. Oppy (ed.), *Ontological Arguments*, 276-294. Cambridge University Press.
- Schaffer, J. 2010. The Internal Relatedness of All Things. *Mind* 119: 341-376.
- Schmid, J.C. 2024. Benardete Paradoxes, Patchwork Principles, and the Infinite Past. *Synthese* 203: 51.
- Schmid, J.C. Forthcoming. The End is Near: Grim Reapers and Endless Futures. *Mind*. DOI: <https://doi.org/10.1093/mind/fzad065>.
- Schmid, J.C. and Malpass, A. 2023. Branching Actualism and Cosmological Arguments. *Philosophical Studies* 180: 1951-1973.
- Segal, A. 2015. Half-Hearted Humeanism. *Oxford Studies in Metaphysics* 9: 262-305.
- Shackel, N. 2005. The form of the Benardete Dichotomy. *British Journal for the Philosophy of Science* 56: 397-417.
- Sorensen, R.A. 1998. Yablo's paradox and Kindred infinite liars. *Mind* 107: 137-155.
- Wilson, J. 2010. What is Hume's Dictum, and Why Believe It? *Philosophy and Phenomenological Research* 80: 595-637.
- Yablo, S. 1993a. Is conceivability a guide to possibility? *Philosophy and Phenomenological Research* 53: 1-42.
- Yablo, S. 1993b. Paradox without self-reference. *Analysis* 53: 251.
- Yablo, S. 2000. A reply to new Zeno. *Analysis* 60: 148-151.