

A Universe of Explanations

Ghislain Guigon, University of Geneva

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Metaphysical considerations suggest that to be a serious candidate for describing actuality, a spacetime should be maximal. For example, for the Creative Force to actualize a proper subpart of a larger spacetime would seem to be a violation of Leibniz's principles of sufficient reason and plenitude. If one adopts the image of spacetime as being generated or built up as time passes then the dynamical version of the principle of sufficient reason would ask why the Creative Force would stop building if it is possible to continue. (...) Some readers may be shocked by the introduction of metaphysical considerations in the hardest of the "hard sciences." But in fact leading workers in relativistic gravitation, though they don't invoke the name of Leibniz, are motivated by such principles (see, for example, Geroch 1970, p. 262; Penrose 1969, p. 253).

John Earman¹

1. Introduction

We can distinguish between two fundamental questions about explanation. The first one, "What is explanation?", may be called the General Explanation Question. The second one, "Under what circumstances do truths have an explanation?", may be called the Special Explanation Question. An answer to the General Explanation Question may take two forms. It may take the form of an analysis of the notion of explanation or it may consist in an axiomatic theory that articulates the most general principles about explanation. On the other hand, the Special Explanation Question is the demand for necessary and jointly sufficient conditions any truth must satisfy in order for it to be

¹ In Earman 1995, pp. 32-3.

the case that it has an explanation. Within the past few years, there has been a growing body of philosophical literature concerning the General Explanation Question. By contrast, I think that it is fair to say that the Special Explanation Question, with which this paper is concerned, has received less attention.

The distinction between the General and the Special Explanation Questions should be reminiscent of Peter van Inwagen's (1990) famous distinction between the General Composition Question (What is composition?) and the Special Composition Question (When does composition occur?). The analogy is intended to suggest that there are three general answers to the Special Explanation Question: always, never, and sometimes. I call *explanatory universalism* the first of these answers. According to explanatory universalism, truths have an explanation under every circumstance. In other words, explanatory universalism is the view that the early modern rationalist principle of sufficient reason (hereafter, PSR) is true:

PSR: For any proposition x , if x is true then there is a proposition y such that y explains x .²

The second answer to the Special Explanation Question may be called *explanatory nihilism*. It is the view that every truth is *brute*, *i. e.* unexplained. According to the third answer to the Special Explanation Question, explanation is restricted to a certain class of truths, which means that some truths have an explanation while others are brute.

I believe that answers to the Special Explanation Question deserve the attention of philosophers. First, these theses have consequences about answers to what we may call *applied explanation questions*. Roughly, an applied explanation question is a question of the form "What

² Here I follow other authors in interpreting PSR as a principle about explanation; see e.g. Della Rocca 2010, p.1, Meyer 2012, and Graham Oppy 2006, pp. 275-90. I should emphasise that Della Rocca (2010) uses the label "*rationalism*" to refer to the view that PSR is true. But the label "explanatory universalism" is a better mnemonic device for distinguishing this from other answers to the Special Explanation Question. Moreover, "rationalism" connotes philosophical theses about innate ideas and *a priori* knowledge that are independent of PSR. Using the label "explanatory universalism" avoids confusion.

explains what?”—or “What is more fundamental than what?” Applied explanation questions play central roles in various fields of inquiry. Some have recently argued that one of the most central questions of metaphysics is “What *metaphysically* explains what?” or “What grounds what?”³ On the other hand, a fundamental question of physics is arguably “What physically explains what?”⁴ The Special Explanation Question can rightly be regarded as *metametaphysical* in the sense that answers to this question have methodological implications about the way we answer applied explanation questions. For instance, it seems that one must believe that explanatory nihilism is false in order to be justified in maintaining that there is a non-vacuous answer to applied explanation questions. Furthermore, it has become a common practice in philosophy to claim that some specific phenomenon is brute or unexplained—e.g. truth, composition, resemblance, naturalness, etc. Brutalist strategies seem to rely on the assumption that admitting that some truths have no explanation is permitted in some circumstances. Yet one may wonder whether there are such circumstances and what they are. But this means engaging with the Special Explanation Question.⁵

Second, answers to the Special Explanation Question may appear to conflict with general principles about explanation, as the following discussion shall illustrate. Yet if some of our beliefs about the correct answer to the Special Explanation Question conflict with some of our beliefs

³ See e.g. Schaffer 2009 and Paul 2012.

⁴ Although this question is, in practice, often subsumed under the question: Which model or theory is best to explain the *phenomena*? For instance, big bang theory has been judged superior to the steady state theory because it provides an explanation for the cosmic microwave background radiation.

⁵ Notice that if we assume that there are several *species* of explanation, e. g. metaphysical, physical, and biological explanations, then we can distinguish between *species* of the Special Explanation Question: in which circumstances does metaphysical explanation arise? In which circumstances does physical explanation arise? Etc. Different answers to these questions are compatible. For instance, one may endorse explanatory universalism about physical explanation—each truth that represents a state of the universe has a physical explanation—and explanatory nihilism about metaphysical explanation—metaphysical explanation never takes place. In this article, I shall not commit myself to any particular view about *species* of explanation because my focus is on the *genus*: explanation. But notice that sometimes it seems wrong to interpret a brutalist claim as the claim that some truth has no explanation *tout court*. Sometimes such claims are better interpreted as meaning that some facts lack a certain *species* of explanation. For instance, a nominalist who takes the resemblance of red particulars as being brute only intends to claim that this fact has no further *metaphysical* explanation. Her intention, however, is not to claim that there is no *physical* explanation of the resemblance of red particulars.

about general principles about explanation, some of these beliefs have to be revised. I believe that there is no good ground to assume *a priori* that our beliefs about which general principles about explanation are true are more immune to revision than our beliefs about answers to the Special Explanation Question.⁶ Thus investigating possible conflicts between answers to the General and the Special Explanation Questions seems to be a good place to start developing a reasoned picture of the explanatory structure of the world.

This article is a modest contribution to this programme as its focus is on explanatory universalism. Explanatory universalism corresponds to the traditional doctrine according to which PSR is true, a doctrine that has been held by philosophers like Aquinas, Spinoza, and Leibniz among others. Despite its impressive intellectual pedigree, PSR is routinely dismissed as an unsupported metaphysical dogma. However, I share the early modern rationalists' warm feelings towards PSR. For explanatory universalism is an intuitive and elegant doctrine. When asked to answer a meaningful why-question, our natural attitude is always to think that this question is *in principle* answerable, even if it may be impossible for us to *know* its answer. Of course, why-questions are sometimes vexing, and frustration may lead us to entertain the possibility of the question being unanswerable. But if the question truly makes sense, and if there really is a fact of the matter about the truth of the *explanandum*, then it seems to me very difficult to admit that such a truth just emerged out of nothing. Michael Della Rocca (2010) has recently argued that proponents of the restricted answer to the Special Explanation Question must provide a principled account of why inexplicability is sometimes acceptable while in most cases it isn't. Like him, I think that in the absence of such an account the division between explained and brute truths appears incomplete. For the absence of such an account means that proponents of a restricted answer to the Special Explanation Question fail to provide necessary and jointly sufficient conditions any truth must

⁶ Taking the analogy with the debate about composition seriously here may be instructive. Extensional mereology may rightly be conceived of as an answer to the General Composition Question. Considering the debate on the Special Composition Question, it is noticeable that some philosophers take agreement with extensional mereology as a virtue, whereas other philosophers have claimed to be warranted in endorsing an answer to the Special Composition Question that appears to conflict with extensional mereology.

satisfy in order for it to be the case that it has an explanation. By contrast, explanatory universalism provides a unified picture of the explanatory structure of the universe. Moreover, it seems that science, throughout its history, has developed under the fruitful working hypothesis that what happens in the world must be explicable. And as the opening quotation from John Earman (1995) suggests, PSR may play an important role in discriminating cosmological models that are good candidates for describing reality.⁷

This article is going to defend explanatory universalism from a simple and direct valid argument according to which PSR has the consequence that there is a truth that explains every truth, namely an *omni-explainer*. I shall describe this argument in section 2. I have no doubt that opponents to PSR would agree that this argument challenges explanatory universalism. For the claim that there is an omni-explainer is counterintuitive on its face. But I suspect that several explanatory universalists may be willing to endorse the conclusion that, if PSR is true, then there is an omni-explainer. My purpose in section 3 is to explain why explanatory universalists should not endorse the strategy that consists in biting the bullet in favour of the existence of an omni-explainer. The reason why biting the bullet in favour of an omni-explainer is wrong is that the existence of an omni-explainer conflicts with the principle that explanation is irreflexive. Section 3 is thus a defence of the principle that explanation is irreflexive that consists of two steps. First, on the assumption that PSR yields that there is an omni-explainer, the most natural and plausible way to relax the principle of irreflexivity of explanation yields a counterintuitive doctrine, namely *necessitarianism*. Second, general considerations on explanation support the view that no further way of relaxing the ban on self-explanations is warranted. So, in light of my defence of the irreflexivity of explanation, the argument according to which PSR implies that some truth explains all truths constitutes a powerful argument against explanatory universalism. But, in section 4, I shall

⁷ I say that PSR seems to play an *important* role here, not that it plays an *essential* role. As a referee has remarked correctly, the full strength of PSR may not be required to motivate the space-time maximality principle Earman is talking about. Non-arbitrariness about the “theatre of dynamics” may be enough. But Earman’s point is that PSR seems to be the underlying metaphysical assumption behind the view that the “theatre of dynamics” is non-arbitrary.

argue that explanatory universalists can resist this argument. For it relies on an assumption that explanatory universalists can legitimately reject, namely the assumption that explanation distributes over conjunction. In the final section, I consider a plausible revision of this assumption. I argue there that, given the revised assumption, explanatory universalism seems to yield a striking picture of the explanatory structure of the universe. I shall indicate why the resulting model does not appear utterly implausible to me.

2. Explaining all truths

Explanatory universalists maintain that whatever is the case has a sufficient reason for its being the case, hence that PSR is true. Early modern rationalists have suspected that we can derive from this principle that there is a sufficient reason for whatever is the case. Given my understanding of PSR in terms of explanation, the claim that there is a sufficient reason for whatever is the case amounts to the thesis that there is an *omni-explainer*:

Omni-explainer: there is a true proposition x such that, for any proposition y , if y is true, then x explains y .

One may expect an argument from PSR to the thesis that there is an omni-explainer to involve a quantifier shift fallacy or some strong assumptions about the explanatory structure of the universe. But no, there is a simple and direct valid argument from PSR to the thesis that some truth explains every truth that only appeals to the assumption that explanation is *dissective*:

Dissection: For any propositions x , y , and z , if z is an explanation for $(x \ \& \ y)$, then z is an explanation for x and z is an explanation for y .

Dissection is a corollary of the claim that explanation is monotonic, *i.e.* the claim that any

explanans explains all the logical consequences of what it explains.⁸ There are powerful reasons to deny monotonicity that are independent of whether *Dissection* is true, however (see below section 4). But my appeal to the claim that explanation is dissective here is motivated by the fact that most authors in the contemporary literature about PSR appear to endorse this claim.⁹

An interesting variation on the notion of an omni-explainer is that of *collective omni-explainers*: for any propositions $x_1, \dots, x_n \dots, x_1, \dots, x_n \dots$ are collective omni-explainers when whatever is the case is explained to be the case by one or the other of $x_1, \dots, x_n \dots$. The notion of collective omni-explainers is worthy of attention because the claim that there are collective omni-explainers directly follows from PSR: if every truth has an explanation, then there are true propositions $x_1, \dots, x_n \dots$ such that whatever is the case is explained to be the case by one or the other of them. The logical link between PSR and the thesis that there are collective omni-explainers is the ground for the argument called to attention here.¹⁰

Roughly, the argument runs as follows. If we assume for *reductio* that there are collective omni-explainers but no omni-explainer *tout court*, then we can map each of the collective omni-explainers onto a true proposition that it does not explain. Then if we form the conjunction of these mapped-to propositions, it follows from the claim that some truths collectively explain all truths that some of the collective omni-explainers, call it O, explains this conjunction. However, given *Dissection*, if O explains the conjunction of mapped-to propositions, O explains each of its conjuncts too. But this leads straight to a contradiction. For given the assumption that there is no omni-explainer *tout court*, there has to be a truth that O does not explain, and this truth has to be a conjunct of the conjunction of mapped-to propositions. But, given *Dissection*, O explains each of the conjuncts of this conjunction. So by *reductio* if explanation is assumed to be dissective, the

⁸ Cf. Humberstone 1985, pp. 401-2. In general, an operator O is monotonic if and only if, for any propositions x and y , if y is a logical consequence of x , then Oy is a logical consequence of Ox .

⁹ These authors include van Inwagen (1983), Bennett (1984), Hudson (1997), Pruss (2006), Oppy (2006), Della Rocca (2010), and Meyer (2012).

¹⁰ This argument is an adaptation of Humberstone's (1985) derivation of omniscience *tout court* from *collective* omniscience.

claim that there are collective omni-explainers yields the conclusion that there is an omni-explainer *tout court*. Since PSR entails that there are collective omni-explainers we can conclude that PSR entails that there is an omni-explainer *tout court*.

Here is a more precise statement of the argument. For expository purposes, I make the oversimplified assumption that the set of collective omni-explainers contains only two propositions: r and s .¹¹ So on the assumption that r and s are collective omni-explainers, every truth is either explained by r or by s . Suppose for *reductio* that neither r nor s is an omni-explainer *tout court*. Then to each of our collective omni-explainers there corresponds some true proposition that it does not explain. So using the indexed modal operator ‘ E_r ’ to mean ‘ r explains’, for some proposition p , it is the case that

$$(1) p \ \& \ \neg E_r p$$

read as “ p is true and r does not explain p ”. Likewise, using the indexed modal operator ‘ E_s ’ to mean ‘ s explains’, for some proposition q , it is the case that

$$(2) q \ \& \ \neg E_s q$$

read as “ q is true and s does not explain q ”. Then forming the conjunction of the first conjunct of (1) with the first conjunct of (2) we obtain the antecedent of (3)

$$(3) (p \ \& \ q) \rightarrow (E_r(p \ \& \ q) \vee E_s(p \ \& \ q)),$$

¹¹ The argument generalises in a straightforward way to any finite number $n \geq 2$ of collective omni-explainers, as the previous informal sketch of the argument shows, since we can form conjunctions with n terms for all finite $n \geq 2$. Whether the argument still works when an infinite set of collective omni-explainers is assumed is the topic of the appendix.

which is an instance of the claim that r and s collectively explain all truths: if the conjunction of p and q is true, then either r or s explains it as they collectively explain all truths. The antecedent of (3), namely $(p \ \& \ q)$, follows from (1) and (2). So by *modus ponens* we are entitled to derive the consequent of (3). However, given *Dissection*, the consequent of (3) is inconsistent with the conjunction of (1) and (2). For by *Dissection* the first disjunct of the consequent of (3) entails that r explains p , which contradicts (1), and its second disjunct entails that s explains q , which contradicts (2). So by *reductio* either r explains every truth or s does.

This argument can be reconstructed in a bimodal logic of the two operators ‘ E_r ’ and ‘ E_s ’ as a derivation of ‘ $(p \rightarrow E_r p) \vee (q \rightarrow E_s q)$ ’ from (3):

- (3) $(p \ \& \ q) \rightarrow (E_r(p \ \& \ q) \vee E_s(p \ \& \ q))$
- (4) $E_r(p \ \& \ q) \rightarrow E_r p$ by *Dissection* applied to $(p \ \& \ q)$
- (5) $E_s(p \ \& \ q) \rightarrow E_s q$ by *Dissection* applied to $(p \ \& \ q)$
- (6) $(p \ \& \ q) \rightarrow (E_r p \vee E_s q)$ a truth-functional consequence of (3), (4), and (5)
- (7) $(p \rightarrow E_r p) \vee (q \rightarrow E_s q)$ a truth-functional equivalence of (6).

Since (7) entails that either (1) or (2) is false, its import is that either r explains every truth or s does, hence that there is an omni-explainer *tout court*. I should emphasise that none of the disjuncts of (7) can be deduced from (3). Letting ‘ O ’ name an omni-explainer *tout court*, we do not know whether $O = r$ or $O = s$. In general, each of the collective omni-explainers is an equally good candidate to be an omni-explainer *tout court*, and there may be several of them.

So, given *Dissection*, PSR entails that there is an omni-explainer. Explanatory universalists endorse PSR. So, if *Dissection* is true, explanatory universalists are committed to the existence of an omni-explainer, namely a truth that explains every truth. I have no doubt that opponents of PSR would regard this argument as a weighty objection to explanatory universalism. For the claim that there is an omni-explainer is counterintuitive. But I am less certain that every proponent of PSR will appreciate the strength of this argument. For, as I emphasised at the beginning of this section, the

thesis that there is a sufficient reason for whatever is the case is a thesis classical explanatory universalists intended to demonstrate and defend. So the purpose of the next section is to explain why I think that explanatory universalists should not welcome the result that PSR entails that there is an omni-explainer. The reason why they should not welcome this result is that the existence of an omni-explainer conflicts with the principle that explanation is irreflexive, which I shall defend. Some philosophers, both among opponents and proponents of PSR, have thought that some specific failures of this principle are admissible. My task in the next section is to argue that these philosophers are wrong. If I am right, there is no refuge for explanatory universalists in allowing for failures of the principle that explanation is irreflexive. So while the conclusion of the present section is that explanatory universalism has a counterintuitive consequence—namely, that there is an omni-explainer—if *Dissection* is true, the conclusion of the next section shall be that explanatory universalists are in serious troubles if *Dissection* is true. This is the reason why *Dissection* will be the focus of section 4.

3. PSR and the ban on self-explanations

I believe that the strongest reason to resist the claim that there is an omni-explainer is that this claim contradicts the seemingly undeniable principle that explanation is *irreflexive*:

Irreflexivity: For any propositions x and y , if x is an explanation for y , then $x \neq y$.

The claim that explanation is irreflexive is inconsistent with the claim that there is an omni-explainer because an omni-explainer explains *every* truth including itself. So if PSR entails that there is an omni-explainer, it also entails that explanation is not irreflexive. The deduction of an omni-explainer from PSR exhibits an apparent conflict between PSR and the principle that explanation is irreflexive.

Several authors of the tradition have suspected that PSR yields a commitment to the view that

something is its own sufficient reason, hence that PSR conflicts with *Irreflexivity*. But what they have failed to notice is that whether the conflict is genuine or not depends on how explanation interacts with *truth functions*, and in particular with conjunction. For the outcome of the previous section is that PSR entails that there is an omni-explainer—and so conflicts with *Irreflexivity*—provided we assume that *Dissection* is true. In my view, this result puts much dialectical pressure on *Dissection*—which I shall examine in the next section—as *Dissection* seems to be the root of the explanatory universalist’s troubles.

But as I suspect that some explanatory universalists may welcome the result that PSR yields that there is an omni-explainer, I suspect that some explanatory universalists may be tempted to commit themselves to the rejection of *Irreflexivity*. For, undeniably, the claim that there is a certain being whose existence is self-explanatory is a traditional thesis that classical explanatory universalists embraced and aimed to demonstrate. My purpose in this section is to explain why I believe that this reaction to the deduction of an omni-explainer from PSR is misguided. For I shall argue that explanatory universalists should not allow for violations of *Irreflexivity*. If I am right, then my defence of *Irreflexivity* justifies the view that explanatory universalists should not welcome a commitment to the existence of an omni-explainer. For if PSR entails that there is an omni-explainer, *Irreflexivity* leads to the conclusion that PSR is false.

My argument for *Irreflexivity* consists of two steps. In section 3.1, I shall argue that, on the assumption that PSR yields that there is an omni-explainer, the most natural and plausible way to relax the principle of irreflexivity of explanation yields the counterintuitive view that *necessitarianism* is true. In section 3.2, I shall offer a general argument in favour of the view that there is no legitimate way of relaxing the ban on self-explanations. In light of my defence of *Irreflexivity*, the existence of an omni-explainer is inadmissible. So the present section is aimed to strengthen the argument according to which PSR yields that there is an omni-explainer. Nevertheless, this argument is not irresistible, or so I shall argue in section 4.

3.1. Necessitarianism

The view that we can relax the ban on self-explanations seems to be shared by Peter van Inwagen who writes:

Secondly, no *contingent* state of affairs may be its own sufficient reason. This would seem to be an essential feature of the concept of a sufficient reason. (I introduce the qualification ‘contingent’ in order to accommodate those who hold that a necessary state of affairs is its own sufficient reason. Whether or not this is so will make no difference to our argument.) (van Inwagen 1983, p. 203)

According to van Inwagen’s suggestion, adequate answers to the General Explanation Question should not assume *Irreflexivity* among their axioms or theorems. Instead what they should assume is the following qualified version of this principle:

Contingent Irreflexivity: For any contingent propositions x and y , if x is an explanation for y , then $x \neq y$.

The thought seems to be that while, given *Irreflexivity*, no proposition whatsoever is its own explanation, *Contingent Irreflexivity* leaves open the possibility that some necessary proposition explains itself, a possibility some theists take seriously. Van Inwagen’s suggestion appears to me as the most plausible and natural restriction of the principle that explanation is irreflexive. It is worthy of interest here because *Contingent Irreflexivity* also leaves open the possibility that, if there is an omni-explainer, this proposition is a necessary truth that explains itself.

But the problem with van Inwagen’s suggestion is that, given the deduction of an omni-explainer from PSR, if *Contingent Irreflexivity* is assumed, PSR yields *Necessitarianism*:

Necessitarianism: For any proposition x , if x is true then x is necessarily true.

This thesis should be associated with the 17th century Dutch rationalist Spinoza (1985, pp. 433-9), who defended the thesis that nothing in nature is contingent, but all things are of necessity.

Suppose that there is an omni-explainer *O*. Then, given *Contingent Irreflexivity*, *O* cannot be a contingent truth. So *O* must be a necessary truth. But if so, on the further assumption that any *explanans* strictly implies its *explananda*, every truth is necessary. Hence, if PSR is assumed to yield the conclusion that there is an omni-explainer, the further assumption that *Contingent Irreflexivity* is true (and *Irreflexivity* is false) leads to the conclusion that PSR entails *Necessitarianism*.

Philosophers are familiar with the belief that PSR entails *Necessitarianism* because of a famous argument proposed by van Inwagen and others.¹² The main difference between my deduction of *Necessitarianism* from PSR and van Inwagen's argument is that the latter relies on the assumption that the conjunction of all contingent truths can be formed, while mine doesn't rely on such an assumption.¹³ This difference is important because one can resist the assumption that the conjunction of all contingent truths can be formed (Oppy 2006, p. 281).

Another advantage of my derivation of *Necessitarianism* from PSR compared to van Inwagen's original argument is that it allows me to emphasise that restricting the principle of irreflexivity of explanation to contingent truths is essential in order to deduce *Necessitarianism* from PSR. For a crucial step in the derivation of *Necessitarianism* from PSR is the deduction of the

¹² See also Hill (1982) and Bennett (1984, p. 115). Van Inwagen's argument runs as follows. Assume that PSR is true and *Necessitarianism* is false. *Necessitarianism* being false there are contingent truths. Form *c* the conjunction of all contingent truths. Conjunctions of contingent truths are contingent and true; hence *c* is a contingent truth. By PSR there is an explanation, say *e*, for *c*. Since explanation is *factive*, *e* is true. If so, *e* is either necessarily or contingently true. If *e* is necessarily true, then, on the further assumption that any *explanans* strictly implies its *explananda*, so are *c* and its conjuncts. But this result conflicts with our assumption that there are contingent truths of which *c* is the conjunction. So *e* must be contingent. But if *e* is a contingent truth, *e* is a conjunct of *c*. By *Dissection* we can derive that *e* explains itself, contrary to the assumption that no contingent proposition is self-explanatory. So *e* must be a necessary truth. Yet we have already seen that this result conflicts with the assumption that *Necessitarianism* is false. Therefore, if PSR is true so is *Necessitarianism*.

¹³ The deduction of an omni-explainer from PSR only appeals to an arbitrary conjunction *x* such that to each of the collective omni-explainers *y* there corresponds a conjunct of *x* that *y* does not explain. That there is such a conjunction follows from PSR and the claim that no proposition is an omni-explainer *tout court*, which we assumed for *reductio*.

claim that there is an omni-explainer. Yet if *Irreflexivity* holds unrestrictedly, no truth whatsoever is an omni-explainer and so *Necessitarianism* cannot be deduced.¹⁴

So, *prima facie*, the strategy that consists in biting the bullet in favour of the existence of an omni-explainer and in admitting that there may be a self-explanatory necessary truth (and no self-explanatory contingent truth) is *wildly* unappealing. For this strategy yields the counterintuitive conclusion that *Necessitarianism* is true. If a commitment to PSR requires us to endorse both the claim that there is an omni-explainer and the claim that *Necessitarianism* is true, then I think that we might well wonder whether the game is worth the candle. For the belief that things may be different than they are is both deeply entrenched into our system of beliefs and well-motivated.

But I should emphasise that Michael Della Rocca (2010), who defends PSR, thinks that the game is worth the candle even if PSR yields *Necessitarianism*. Della Rocca writes:

Precisely because necessitarianism is an implication of the PSR, the intuitive pressure leading to the PSR is intuitive pressure leading to necessitarianism. A clear-headed proponent of the PSR can be expected to embrace necessitarianism for precisely this reason. (Spinoza certainly did.) “Oh, that necessitarianism stuff is something I knew about all along,” the rationalist might say. (Della Rocca 2010, p. 9)

According to Della Rocca, the deduction of *Necessitarianism* from PSR merely confirms what he knew all along, namely that *Necessitarianism* is part of the explanatory universalist doctrine. Then since he thinks that PSR is intuitive he concludes that *Necessitarianism* is intuitive too. This is provocative. But whatever one’s views about the plausibility of *Necessitarianism*, I believe that

¹⁴ That *Necessitarianism* does not follow from PSR if *Irreflexivity* is assumed to hold unrestrictedly is true of van Inwagen’s original argument too. For suppose for *reductio* that *Necessitarianism* and PSR are both true. Then let us assume that we can form the conjunction of all (necessary) truths. By PSR this conjunction has an explanation. By *Necessitarianism* this explanation is a necessary truth. But if so the explanation of the conjunction of all (necessary) truths is a conjunct of this conjunction. Given *Dissection*, the explanation of the conjunction of all necessary truths explains itself, which contradicts *Irreflexivity*. Therefore, if *Irreflexivity* holds unrestrictedly and *Dissection* is true, then PSR is *incompatible* with *Necessitarianism*.

Della Rocca's "clear-headed proponent of PSR" is getting confused. For, as I have explained, the view that PSR implies *Necessitarianism* is false if no proposition whatsoever explains itself. Yet, on Della Rocca's own lights, there are strong reasons to stand firm on the ban on self-explanations. I shall discuss these reasons to maintain *Irreflexivity* in section 3.2. My argument will allow me to reject further restrictions of the principle that explanation is irreflexive that have been defended by Hud Hudson (1997) and Alexander Pruss (2006).

3.2. Standing firm on the ban on self-explanations

Several explanatory universalists have committed themselves to failures of *Irreflexivity*. First, Della Rocca has endorsed the view that *Necessitarianism* follows from PSR. Yet since *Necessitarianism* follows from PSR *only if* we admit a self-explanatory necessary truth (see above), Della Rocca's position is coherent only if he denies that *Irreflexivity* holds unrestrictedly. Other explanatory universalists have thought that they can *avoid* the conclusion that *Necessitarianism* follows from PSR by admitting some further violations of *Irreflexivity*. Hudson (1997) has proposed to admit *true necessary falsehoods* in order to avoid a commitment to *Necessitarianism*. He argues that the existence of true necessary falsehoods appears justified if we endorse David Lewis's (1986a) genuine modal realism and the doctrine of unrestricted composition.¹⁵ Then if we assume that the omni-explainer is neither a contingent nor a necessary truth but a true necessary falsehood, *Necessitarianism* does not follow from the claim that there is an omni-explainer. Yet if the omni-explainer is a true necessary falsehood, then there is a *self-explanatory* true necessary falsehood. Finally, Alexander Pruss has maintained that there is a good candidate for a self-explanatory *contingent* truth (2006, pp. 97-125). Pruss's candidate is a proposition that represents a libertarian free action of creation (2006, p. 124). The situation Pruss has in mind involves a necessarily existing and essentially good God who, when deciding what kind of a universe to create, finds that

¹⁵ See Feit 1998 for a reply to Hudson's argument regarding the link between genuine modal realism and the thesis that there are true necessary falsehoods.

no world is the best of all; and so God chooses to create one of the best worlds freely (2006, pp. 116-7). Thus Pruss's cosmological scenario implies the rejection of *Contingent Irreflexivity*.

I believe that the general strategy of these explanatory universalists is misguided because I contend that we are justified in maintaining that *Irreflexivity* is true.¹⁶ So here I shall offer a general argument for *Irreflexivity* following which *no* violation of *Irreflexivity* should be allowed.

Several writers have emphasised that explanation and cognate notions are fundamentally irreflexive. For instance, Oppy writes:

If one asks "Why S?", one can never be satisfied with the alleged explanation "Because S!" (...). It is true that in colloquial language it is common for people to say that something or other is "self-explanatory"; but what they mean when they say this is usually that the thing in question is obvious, not that it literally provides its own explanation. (...) As intimated above, "A because A" is always an explanatory solecism; hence "A explains A" can never be true. (Oppy 2006, pp. 277-8)

If "*p* because *p*" is a mistake of the grammar of explanation, then *Irreflexivity* must be a formal truth that holds of any proposition. In a similar vein, Benjamin Schnieder (2011, p. 454) claims that " $\neg(p \text{ because } p)$ " is a theorem of his logic for 'because'. Last but not least, Kit Fine (2012, p. 5) assumes as a constitutive rule of inference of his pure logic of ground that strict ground operators

¹⁶ If pressed to explain why I am not convinced by Pruss's particular alleged counterexample to *Contingent Irreflexivity*, I should say that the reason why, in his scenario, God acted *indifferently* is that no world is the best overall. Since the proposition that there is no best world overall is undoubtedly distinct from that representing God's action, I don't see why we should admit a violation of *Irreflexivity* here. Some may reply that the proposition that no candidate for creation is the best universe overall does not suffice to fully explain why it is this world, instead of another one, that has been created. I could not agree more. But if so, the right conclusion is that Pruss's scenario is a counterexample to PSR. Modern explanatory universalists would have agreed with me on this conclusion. Spinoza himself denied that God has a free will on the basis of PSR. But he also denied that the world is created. Leibniz, on the other hand, maintained that PSR entails that some world is better than any other world. Otherwise, God would have no reason to act: "And to say that the mind will act when it has reasons to act, even if the ways of acting are absolutely indifferent—this is to speak again very superficially and quite indefensibly. For you don't have a sufficient reason to act unless you have a sufficient reason to act in precisely such-and-such a way (...) So when there's a sufficient reason to do any particular thing, there's also a sufficient reason to do it in a certain particular way, which means that the various alternative ways of doing it are not indifferent. . . ." (Alexander 1956, Leibniz's 5th paper).

are non-circular, *i.e.* that nothing strictly grounds itself. The notion of a strict ground is firmly connected to that of an explanation. As Fine writes

We might think of the strict grounds as moving us down in the explanatory hierarchy. They always take us to a lower level of explanation and, for this reason, a truth can never be a strict ground for itself. (Fine 2012, 3)

Here Fine appears to justify the non-circularity of the strict ground operator in terms of the irreflexivity of explanation. So, *contra* these explanatory universalists that I mentioned at the beginning of this section, there seems to be a wide consensus in contemporary metaphysics in favour of the view that explanation and cognate notions are irreducibly irreflexive. If this consensus is justified, we should not relax the ban on self-explanations.

But is it justified? I think so. Consider Della Rocca's account of the rejection of explanations by means of Aristotelian forms by early modern philosophers:

Such forms were introduced—or so the caricature goes—to explain changes in the world. A pan becomes hot, for example, because it acquires the form of heat. Such explanation came to be seen and is still seen by most as bankrupt. To explain something's becoming hot in terms of its acquisition of the form of heat is trivial: in order to explain why the pan becomes hot, we need to appeal to features *not so closely tied*—as the form of heat is—to the phenomenon to be explained. If explanation of a certain phenomenon by means of such forms were the whole explanation, then this phenomenon would remain inexplicable. (Della Rocca 2010, p. 3; my emphasis)

Della Rocca's account seems correct to me. But why is it that, if explaining p in terms of q is trivial, p remains unexplained? This is so because a plausible requirement on explanations is that, in order for q to be an explanation for p , q must be informative about p .¹⁷ Given that by definition an alleged

¹⁷ An instance of this principle is Lewis's (1986b, pp. 217-8) claim that a causal explanation must be informative about

explanation that is trivial is not informative, no genuine explanation is trivial. But why are alleged explanations by Aristotelian forms trivial? Della Rocca thinks that they are so because he maintains the following:

Distance: for any x and y , if x and y are *too closely tied*, then x is neither an explanation for y nor is y an explanation for x .

What ‘closely tied’ means here is vague. Still there is a clear connection between the notion of an alleged explanation that is insufficiently informative and that of an alleged *explanans* that is too closely tied to its *explanandum*. If the transmission of information is a necessary requirement on explanations, so is *Distance*. *Distance* entails, however, that no proposition whatsoever can be its own explanation. This is because, for every proposition x , no proposition is more closely tied to x than x itself. So here is one way of justifying *Irreflexivity*: the requirement of transmission of information justifies *Distance*, which itself justifies *Irreflexivity*. I believe that this way of reasoning is correct. Therefore, I contend that we should stand firm on the ban on self-explanations.

But if so, Della Rocca seems to be hoist by his own petard. Given his commitment to *Distance*, he must commit himself to *Irreflexivity*. But then his open-minded attitude towards *Necessitarianism* is irrelevant. For given *Irreflexivity*, if the derivation of an omni-explainer is sound, PSR does not entail *Necessitarianism* (see section 3.1). Since I agree with Della Rocca that *Distance* is true, biting the bullet in favour of *Necessitarianism* as he does is not a strategy that I can recommend to any “clear-headed” proponent of PSR.

Moreover and more importantly, since I maintain *Irreflexivity*, I contend that explanatory universalists cannot endorse the claim that there is an omni-explainer. For, given *Irreflexivity*, explanatory universalism is refuted if PSR implies that there is an omni-explainer. According to me then, there is only one adequate way explanatory universalists can evade this problem: they must

the *causal history* of the *explanandum*.

solve it by showing that PSR does not imply that there is an omni-explainer. But the claim that there is an omni-explainer follows from PSR by *Dissection*. This means that explanatory universalism is false if *Dissection* is true. Fortunately, *Dissection* is not true, or so I shall argue in the next section.

4. Conjunction and explanation

I do not believe that the deduction of an omni-explainer from PSR is cogent because this deduction essentially relies on *Dissection*, namely the claim that for any propositions x , y , and z , if z is an explanation for $(x \& y)$, then z is an explanation for x and z is an explanation for y . Yet explanatory universalists can legitimately deny *Dissection*, or so I shall argue.

Whether *Dissection* is true depends on how the explanation operator interacts with truth functions, and in particular with conjunction. So let us assume that there is a consequence operator \Rightarrow^* such that, necessarily, for any propositions x and y , x explains y iff x is true, $x \neq y$, and $x \Rightarrow^* y$. Then whether *Dissection* is true depends on the strength of \Rightarrow^* . Of course, *Dissection* is true if \Rightarrow^* is assumed to be as strong as material implication or classical entailment. But there is a powerful reason to think that \Rightarrow^* must be stronger than both classical material implication and classical entailment. This reason has to do with *relevance*. Intuitively, for a proposition to explain another, the former must contribute to the obtaining of the latter. In other words, the *explanans* must be relevant to the *explanandum*. However, if \Rightarrow^* is as weak as classical material implication or classical entailment, then a true proposition may turn out to have a fully irrelevant *explanans*. If \Rightarrow^* is understood in terms of classical material implication, then the fact that François Hollande is the actual president of France explains why the Earth rotates towards the east. If \Rightarrow^* is understood in terms of classical entailment and there are both contingent and necessary truths, then every necessary truth, and *a fortiori* every logical necessity, turns out to be explained by every contingent truth. It is for such reasons that the claim that explanation is classically monotonic, *i. e.* the claim that any *explanans* explains all the (classical) logical consequences of what it explains, appears implausible. For this claim generates fully irrelevant explanations. So the claim that explanation is

classically monotonic does not constitute a legitimate reason to assume that *Dissection* is true.

A natural thought, then, is to conceive of \Rightarrow^* in terms of relevant implication. The suggestion is that, for any distinct and true propositions x and y , x is a sufficient reason or full explanation for y if and only if x is a true relevant sufficient condition for y , and $x \neq y$. This suggestion entails that *Dissection* is true. For, for any x , y , and z , if z relevantly implies $(x \& y)$, z relevantly implies x and relevantly implies y by suffixing and $\&$ -elimination.¹⁸ However, I shall argue that there are good reasons to maintain that explanation is stronger than relevant implication. These reasons imply that *Dissection* is false.

Consider the following quotation from the famous explanatory universalist Leibniz:

Now, by that single principle, viz. that there ought to be a sufficient reason why things should be so, *and not otherwise*, one may demonstrate the being of a God, and all the other parts of metaphysics or natural theology; and even, in some measure, those principles of natural philosophy, that are independent upon mathematics: I mean the dynamical principles, or the principles of force. (Alexander 1956, 2nd paper, §1; my emphasis)

According to Leibniz, a sufficient reason or full explanation for a proposition must tell us why things are so *and not otherwise*. This means that, for Leibniz, a genuine explanation for a proposition must be *discriminatory*: it must discriminate the actual situation from counterfactual ones.¹⁹ Such an account of explanation requires that, in order for a proposition to explain another,

¹⁸ The suffixing axiom of relevant logic states that, for any x and y , if x relevantly implies y , then, for any z , if y relevantly implies z then x relevantly implies z . The $\&$ -elimination axiom states that, for any x and y , $(x \& y)$ relevantly implies x and relevantly implies y .

¹⁹ On the discriminatory feature of explanation see also the quote from Leibniz in note 16 above. Let me emphasise that Leibniz maintained that there are necessary truths. So if his principle of sufficient reason is meant to apply to these truths as well, as it certainly is, then his requirement that explanations tell us why things are so, *and not otherwise*, implies us to have a look at *impossible* counterfactual situations. These situations may correspond to the *non-normal* worlds, or “logic fictions”, of the semantics for relevance logic; see Priest 2008. As a matter of fact, Leibniz does consider a world that is, according to him, such a logic fiction when he replies to Clarke. He calls such worlds merely “abstractly possible” and maintains that there are some abstract possibilities that fail to be genuine metaphysical

the former proposition must be relevant to the latter. However, requiring that the *explanans* contains *some* chunk of relevant information about the *explanandum* is not enough if what we want is to *fully* explain why things are so *and not otherwise*. For let us suppose that p relevantly implies q while r is irrelevant to q (where p , q , and r are three distinct truths). Then $(p \ \& \ r)$ is a true proposition that contains some relevant piece of information about q . Yet if one attempts to explain why q is the case by merely appealing to $(p \ \& \ r)$, one fails to say whether q would be true or false if p were false and r were true or whether q would be true if p were true and r were false, despite the fact that these questions have a determinate answer. Merely explaining q in terms of $(p \ \& \ r)$ does not suffice to discriminate the actual state of the universe from counterfactual states of the universe because it does not tell us on what, within $(p \ \& \ r)$, q genuinely depends. This is the reason why $(p \ \& \ r)$ is not a sufficient reason, or genuine explanation, for q on Leibniz's account of a sufficient reason. But if so, the Leibnizian account of explanation is incompatible with *Dissection*. For *Dissection* typically generates alleged explanations that contain chunks of information that are irrelevant to the *explanandum*.

Let me assume that the following is a satisfactory explanation of why a is black: a is black because a is a raven and genetic mechanisms X occur within all ravens that are responsible for biochemical reactions Y which produce their distinctive black pigmentation. And let me assume for the sake of the argument that the fact that I placed a mug on my desk explains that there is a mug on my desk. On these assumptions, the following appears to be a plausible explanation of why a is black and there is a mug on my desk: a is black and there is a mug on my desk because a is a raven, genetic mechanisms X occur in all ravens which are responsible for biochemical reactions Y which produce their distinctive black pigmentation, and I placed a mug on my desk. So by *Dissection* we can derive that a is black because a is a raven, genetic mechanisms X occur in all ravens which are

possibilities because they violate PSR: "This supposition of two indiscernibles—e.g. two pieces of matter that are perfectly alike—does indeed seem to be abstractly possible, but it isn't consistent with the order of things, or with God's wisdom, which doesn't allow anything without reason. Ordinary lay-people fancy such things because they rest content with incomplete notions, thus regarding something as outright possible on the grounds that it is abstractly possible." Alexander 1956, Leibniz's 5th reply.

responsible for biochemical reactions Y which produce their distinctive black pigmentation, and I placed a mug on my desk. But it seems that a would still be black in a counterfactual situation in which I had placed no mug on my desk. That I placed a mug on my desk is irrelevant to explain why a is black. Indeed, knowing that I placed a mug on my desk does not increase our understanding of why a is black. This information seems parasitic on what explains that a is black instead of being part of a genuine explanation of why a is black. So it is counterintuitive to think that the proposition that I placed a mug on my desk can take place in a genuine explanation of why a is black. I believe that the Leibnizian account of explanation is motivated by such intuitions.

In the previous example, *Dissection* yields an alleged explanation of why a is black that does not tell us whether a would be black in a situation in which I placed no mug on my desk, although this question has a determinate answer. In general, the point is that for any propositions w , x , y , and z such that w explains x and y explains z , if we assume that $(w \ \& \ y)$ explains $(x \ \& \ z)$, then *Dissection* entails that $(w \ \& \ y)$ explains both x and z despite the fact that y may be irrelevant to x and w to z . In such a case, explaining x in terms of $(w \ \& \ y)$ does not tell us whether x would be true if w were true and y were false, and it does not tell us whether x would be true if w were false and y were true, although these questions have a determinate answer. So *Dissection* generates alleged explanations that do not tell us how the *explanandum* is connected with the alleged *explanans* because they contain *too much* information. According to the Leibnizian account of explanation, such alleged explanations are mere *pseudo* explanations. For they fail to explain why things are so, *and not otherwise*. So *Dissection* is incompatible with the Leibnizian account of explanation that I favour.

But is the Leibnizian account of explanation plausible? James Woodward has argued that a successful scientific explanation should not merely provide a nomologically sufficient condition for the *explanandum*, but should be such that it “could be used to answer a set of what-if-things-had-been-different questions” that “insure that the *explanans* will perspicuously identify those conditions which are relevant to the *explanandum* being what it is” (Woodward 1979, p. 55) (see also Woodward 2003). The claim is that a successful act of explanation should not only tell us that

the *explanandum* derives from the alleged *explanans* but should tell us *how* the *explanandum* depends on the alleged *explanans* (Hitchcock 2005, p. 112). Of course, what Woodward and Hitchcock are talking about here are *linguistic acts* of explanation rather than the ontological and objective notion of explanation that is relevant to the purpose of this paper and is independent of any such act. But linguistic acts of explanation are intended to grasp, or to make intelligible, the explanatory connections that take place in the world. So it is reasonable to think that, if Woodward and Hitchcock are right about the fact that acts of explanation are successful only if they tell us how the *explanandum* depends on the alleged *explanans*, then this can only be because something like the Leibnizian fine-grained account of explanatory connections in the world is true.²⁰

In this section, I have argued that the great explanatory universalist Leibniz is committed to the view that a proposition is not merely another true proposition that relevantly implies the latter. Then I have argued that the Leibnizian fine-grained view about explanation is incompatible with *Dissection*. The view is that a genuine explanation must only contain those true sufficient conditions that are relevant to the obtaining of the *explanandum* in order to discriminate why things are so and not *otherwise*. Since *Dissection* typically generates alleged explanations that contain superfluous information, it is false on the Leibnizian view. Finally, I have emphasised that the Leibnizian view on explanation that I favour is supported by recent considerations concerning the nature of scientific explanations. Therefore, explanatory universalists need not be, and I say are not, committed to *Dissection*. Since the deduction of an omni-explainer from PSR essentially relies on *Dissection*, I conclude that explanatory universalism is not refuted by this argument.

²⁰ Gideon Rosen (2010, pp. 116-7) also seems to share the view that *Dissection* is false. Rosen does not discuss *Dissection* but the related principle that, for any truths x and y , if x explains y , then, for any z , $(x \ \& \ z)$ explains y , which I shall call *Strengthening* (Rosen calls it “monotonicity”, but I prefer to reserve the label “monotonicity” to describe another principle). But Rosen’s reasons to deny *Strengthening* appear to me as close, if not identical, to my reasons to deny *Dissection*. Moreover, the rejection of *Strengthening* appears to imply the rejection of *Dissection*. See also Guigon 2009 and Guigon 2011 for other arguments against *Dissection* understood as a principle about the *bringing about* operator and causal explanation respectively.

5. Coda

I would like to conclude this article by considering a weaker version of *Dissection* that is not challenged by the argument of the previous section and which seems plausible to me:

W-Dissection: For any propositions x , y , and z , if z is an explanation for $(x \ \& \ y)$, then if z is a conjunction, then either z is an explanation for x and z is an explanation for y , or some conjunct of z explains x and some conjunct of z explains y ; if z is not a conjunction, z is an explanation for x and z is an explanation for y .²¹

I am not going to argue for *W-Dissection* here. The reason why I find this principle congenial is that I cannot think of any good reason to reject it. Notice also that the argument of the previous section would justify a general account of the interaction of explanation with truth functions that does not restrict itself to propositions that exhibit a particular syntactic structure (viz., conjunctions).²² But for reasons of space, I shall not pursue this line of inquiry here. The issue I shall focus on is whether PSR still yields an omni-explainer if we substitute *W-Dissection* for *Dissection*. I shall argue that it doesn't.

When casting the deduction of an omni-explainer from the assumption that there are collective omni-explainers, I assumed that there are only two collective omni-explainers: r and s . Now suppose that r is a conjunctive truth having exactly two conjuncts: u and v . And suppose that s is not a conjunctive truth. Then if we substitute *W-Dissection* for *Dissection*, step (4) of the argument must be replaced by

$$(4') E_r(p \ \& \ q) \rightarrow (E_r p \vee E_u p \vee E_v p)$$

²¹ I am greatly thankful to Natalja Deng for having suggested this weaker version of *Dissection* to me.

²² I am grateful to an anonymous referee for stressing this point.

But (7)—the claim that either r or s is an omni-explainer *tout court*—does not follow from (4') and the assumption that s is not conjunctive. Instead what follows from (4') is

$$(7') (p \rightarrow (E_r p \vee E_u p \vee E_v p)) \vee (q \rightarrow E_s q)$$

Since the first disjunct of (7') is compatible with (1)—the claim that p is true but not explained by r —it does not follow from (7') that there is an omni-explainer *tout court*. This means that, if we substitute *W-Dissection* for *Dissection* in the deduction of an omni-explainer from PSR, the conclusion that there is an omni-explainer does not follow, and PSR no more conflicts with the principle that explanation is irreflexive.

Still there is something important about the interaction of PSR, *Irreflexivity*, and *W-Dissection* that this argument reveals. If (7') is true and (7) is false, then by *W-Dissection* it follows that ($p \ \& \ q$) is not explained by s ; otherwise, since s is not a conjunctive truth, the second conjunct of (7') would be true contrary to (2), namely the assumption that s does not explain q . So ($p \ \& \ q$) is explained by r . Since there is no omni-explainer *tout court*, let me assume, this means that at least one proposition, either p or q , is neither explained by r nor by s but by a *further* proposition: a conjunct of r that is neither identical to r nor to s . But if so, it is not the case that r and s collectively explain *all* truths. There are more collective omni-explainers than we started with. Isn't this puzzling?

Yes and no. In fact, I would not be surprised if it could be shown that, for any number n , if we assume as a working hypothesis that there are n collective omni-explainers, then PSR, *Irreflexivity*, and *W-Dissection* together entail that there are more than n collective omni-explainers. If this could be shown, then this would mean that the limit of the set of collective omni-explainers is not attainable, or that this set can never be fulfilled. Such a result should not surprise us too much because we are familiar with the idea that the conjunction of PSR and *Irreflexivity* entails that there is no actual ultimate level of explanation. More astonishing, I suggest, is the result that our

assumptions about how explanation combines with *conjunction* play a determining role in whether PSR and *Irreflexivity* together entail that there is no actual ultimate level of explanation. Now it is true that philosophers tend to repudiate the claim that there is no actual fundamental level of explanation.²³ But, looking at physical cosmology and causal explanation, I wonder if the demand for an actual fundamental level of explanation is not just another dogma of metaphysics.

Standard or Friedmann-Robertson-Walker (FRW) big bang models imply that for every time t there is a time t' that is prior to t and is such that the state of the universe at t' is a cause of the state of the universe at t . In this way, “the principle *Every event has a cause* ... is satisfied in the FRW big bang models” (Earman 1995, p. 209). If every event has a cause, every proposition that represents the occurrence of an event has a causal explanation. So PSR, understood as a principle about *causal* explanation, is true within standard big bang models. In these models, the structure of time is continuous and open.²⁴ This entails that no state of the universe is a cause of itself and that no proposition is its own causal explanation. So *Irreflexivity*, understood as a principle about causal explanation, is also true in standard big bang models. Accordingly, there is no actual fundamental cause, no actual first state of the universe, and so no actual fundamental level of causal explanation in FRW models. But what of the big bang itself then? Well, the whole point is that, in FRW models, the big bang singularity at $t = 0$ is excluded from the class of actual moments of time. The big bang singularity is an *ideal* rather than an actual limit of time. Physicists interpret this claim as meaning that, according to FRW big bang models, the cosmic time interval is *open* in the past. But this does not mean that time is infinite in FRW big bang models. For the duration of the past interval is still *finite*, around fifteen billions years. In a similar vein, a chain of explanations can be open without being infinite, and, strictly speaking, the combination of PSR and *Irreflexivity* merely commit us to such an open chain of explanations.²⁵ Since the past interval is finite, it is impossible to travel

²³ See e.g. Cameron 2008.

²⁴ Cf. Meyer 2012 on the interaction between closed models of time and the principle of sufficient reason. In his article, Meyer rejects PSR on the misleading grounds that PSR entails *Necessitarianism*.

²⁵ A chain of explanations is open if for any point x in this chain, there is a real number $r > 0$ such that the interval $(x +$

infinitely in a *regular* way into the past. Still, in some sense, there are infinitely descending causal chains, and so infinitely descending chains of causal explanation, in FRW big bang models. For the causal chain asymptotically approaches the big bang singularity without attaining it. The closer we are to the big bang, the smaller is the temporal extension of the state of the universe. In this way, as we are approaching the big bang singularity we are approaching the limit of the set of collective causal omni-explainers, and so getting closer to fulfilling this set. But it can never be fulfilled as the limit of the set, the big bang singularity, is not attainable. Therefore, standard big bang models are plausible models of the universe that provide us with an acceptable understanding of what a world without an actual ultimate level of (causal) explanation looks like.

In closing, in this article I have defended explanatory universalism, the view that PSR is true, against an argument that purports to show that PSR entails that some truth explains every truth. This argument constitutes a challenge to explanatory universalism because it implies that PSR conflicts with the principle that explanation is irreflexive, which I have maintained against other proponents of PSR. I have argued that the derivation of an omni-explainer from PSR does not refute explanatory universalism because this argument essentially appeals to *Dissection* which explanatory universalists can legitimately deny. According to me, explanatory universalists should maintain that a genuine explanation of a fact must contain no information that does not contribute to the explanation of this fact. If this is correct, then *W-Dissection*, from which it does not follow that PSR entails that there is an omni-explainer, appears more plausible than *Dissection*.

Naturally, if my defence of explanatory universalism commits me to the claim that there is no actual ultimate level of explanation, I do not expect it to gain large popularity among philosophers. This is a venerable *trilemma*: the principle of sufficient reason, the unrestricted ban on self-explanations, and the claim that there is an actual fundamental level of explanation cannot all be true together. The tradition from Aquinas to Leibniz contends that PSR is true and that there is an

$r, x - r$) is contained in the chain.

actual *self-explanatory* level of explanation, thereby rejecting that explanation is necessarily irreflexive. On the other hand, many contemporary metaphysicians maintain that there is an actual fundamental level of explanation and that nothing is its own explanation, thereby rejecting PSR. But in this domain the metaphysician can learn from physical cosmology. And if standard big bang models are plausible representations of physical reality, then we must acknowledge that a theory that commits us to PSR, to the ban on self-explanations, and to the denial of an actual fundamental level of explanation is not implausible. In any case, such a theory is not refuted by the argument according to which PSR entails that there is an omni-explainer.²⁶

APPENDIX

When stating the derivation of an omni-explainer from the claim that there are collective omni-explainers and *Dissection* in section 2, I have assumed for ease of exposition that the set of collective omni-explainers is finite. But since, given the content of section 5, it does not seem implausible that explanatory universalists are committed to infinitely many collective omni-explainers, one may legitimately wonder whether the claim that there is an omni-explainer still follows from PSR and *Dissection* when an infinite set of collective omni-explainers is assumed.

An objector may think that it doesn't on the grounds that we can only form conjunctions of a *finite* number of propositions. Yet since our argument proceeds by mapping each of the collective omni-explainers onto a true proposition that it does not explain and in forming the conjunction of these mapped-to propositions, if there are infinitely many collective omni-explainers, this conjunction may have an *infinite* number of conjuncts.

Here is a model to illustrate this problem. Let 'G' stand for the set of collective omni-explainers and suppose that $G = \{\dots, o_3, o_2, o_1\}$, which is a backward infinite series and where 'o₁', 'o₂', 'o₃', etc. are names for collective omni-explainers. Suppose that propositions have truth-

²⁶ This paper has benefited greatly from discussions with the members of the eidos Group, the Swiss Centre in Metaphysics. I thank them all. I am especially thankful to my colleagues Natalja Deng, Fabrice Correia, Alexander Skiles, and Alexander Bown. I am also greatly indebted to Karen Bennett, Baptiste Le Bihan, Stephan Leuenberger, Clare Mac Cumhaill, Ulrich Meyer, Graham Peebles, Johannes Stern, and Cain Todd and to anonymous referees for OSM for their useful comments.

functional structure, and that each member of S is atomic. Now suppose that each o_i in the series explains each later member in the series. For instance, o_2 explains o_1 , o_3 explains o_2 and o_1 , and so on. Suppose also that there is another proposition p outside the series that is explained by o_1 but which does not explain anything. In this model, for any collective omni-explainer o_i , the propositions that o_i does not explain always come lower in the series. So we can map each of the collective omni-explainers onto its immediate ancestor for the need of the proof: o_1 can be mapped onto o_2 , o_2 can be mapped onto o_3 and, in general, we can map any o_i onto o_{i-1} . Now the problem is that for the purpose of the argument we would need to be able to form the conjunction of these mapped-to propositions. But since the set of collective omni-explainers is infinite, the set of mapped-to propositions—which is simply the set of immediate ancestors of every collective omni-explainer here—is itself infinite. So if, as my objector thinks, we cannot form infinite conjunctions, we cannot form the conjunction of mapped-to propositions. If so, the deduction of an omni-explainer from PSR is blocked.²⁷

But even if it is assumed that we cannot form the relevant infinite conjunctions, we can still express them by appealing to a truth predicate. The thought that the main purpose of the truth predicate is to represent such infinite conjunctions is traditional among deflationists about truth.²⁸ In this case, the idea is to replace *Dissection* by:

$$\textit{Dissection}\#: \forall S \forall z (E_z(\text{the proposition that all the members of } S \text{ are true}) \rightarrow \forall x \in S E_z x);$$

where *Dissection*# reads “for any set S of propositions and any proposition z, if z explains the proposition that all the members of S are true, then z explains all the members of S”. On the assumption that we can use the truth predicate to represent infinite conjunctions, *Dissection*# should

²⁷ This model was brought to my attention by an anonymous referee to whom I am grateful.

²⁸ See, for instance, Quine 1970, p. 12 : “We may affirm the single sentence by just uttering it, unaided by quotation or by the truth predicate; but if we want to affirm some infinite lot of sentences, then the truth predicate has its use.” See also Halbach 1999.

be as plausible as *Dissection*.

The argument then goes as follows. Let, again, G be a backward infinite series of collective omni-explainers. Suppose for *reductio* that none of the members of G is an omni-explainer *tout court*. Then to each o_i in G we can associate a true proposition $f(o_i)$ that o_i does not explain. Take U the set of all $f(o_i)$ s such that o_i is in G. By *Dissection#*, we get:

$$(\#): \forall o_i \in G (E_{o_i}(\text{the proposition that all the members of U are true}) \rightarrow \forall x \in U E_{o_i}x).$$

Now since the members of G are collective omni-explainers, there is a member o_j of G such that o_j explains the proposition that all the members of U are true. By (#) it follows that, for all $x \in U$, o_j explains x . But since $f(o_j)$ is in U, we get the conclusion: o_j explains $f(o_j)$. Yet by assumption $f(o_j)$ is not explained by o_j . Contradiction. Hence, given *Dissection#*, some member of G is an omni-explainer *tout court*. Q.E.D.

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