Dispositionalism's (grand)daddy issues: time travelling and perfect masks

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1. *Introduction*

Dispositionalism is the view that all modal truths are grounded in the potentialities of actual entities. 'It is possible that the vase breaks' is true because the vase instantiates an irreducibly dispositional property: fragility. The canonical version of the theory is due to Vetter 2015 and consists of the following two theses:[1]

(D$\Diamond$) It is metaphysically possible that *p* iff something has, had or will have an iterated potentiality for it to be the case that *p*.

(D$\Box$) It is metaphysically necessary that *p* iff it is not possible that not-p, that is, iff nothing has, had or will have an iterated potentiality for it to be the case that not-*p*.

We will argue that adopting Dispositionalism creates some special troubles with regard to time travel. In particular, we will argue that adopting Dispositionalism prevents one from dispelling the grandfather paradox – at least as far as we retain the idea that killing one's grandfather is impossible. In short, we will maintain that the following three theses are inconsistent (given some further assumptions, defended below):

(TimeTravel) Time travel is metaphysically possible.

(Possibility) If something has an iterated potentiality for it to be the case that *p*, then it is possible that *p*.

(NoSelfDefeat) It is metaphysically impossible to perform a self-defeating action, such as killing one's grandfather.

We will suggest that the problem at hand is an instance of a more general issue for Dispositionalism, namely that of necessary perfect masks (Vetter and Busse 2022), and that the decision as to which of these theses to ultimately reject will depend, in part, on the broader strategy adopted to tackle that issue.

The paper is structured as follows. In §1 we present a potentiality-based version of the grandfather paradox. In §§2 and 3 we justify the additional premisses needed for the argument. In §4 we show why the standard solutions

1 We also adopt Vetter's (2015) theory of potentialities as being characterized only by their manifestations and directly linked with possibility claims. Adopting a stimulus and manifestation view that directly associates potentialities with counterfactuals (Bird 2007, Jacobs 2010) does not substantially affect the argument.

Analysis Vol. XX | Number XX | XX 2022 | 1–10 doi: https://doi.org/10.1093/analys/anac056
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to the grandfather paradox are not available to the dispositionalist. Finally, in §5 we argue that this is a case of necessary perfect masking. We conclude in §6.

2. *The problem*

The central idea of the grandfather paradox is that, were time travel possible, there seems to be nothing that would stop one from performing certain self-defeating actions. These are actions that, if performed, would have prevented the very action to occur, for example killing one's younger self. Consider the case in which Tim wants to go back in time and kill his grandfather ('Gramps' hereafter) before Gramps could generate one of Tim's parents. Tim has a gun in his hands, he is able to shoot and all the conditions to commit the murder are perfect. It then seems that he could kill Gramps. However, he *could not* kill Gramps (his attempt must fail); had he done it, Tim would not have been born. If Tim had not been born, he could not have travelled back in time to kill his grandfather. It is impossible for Tim to kill Gramps, hence the inconsistency between the possibility of time travel, the resulting ability to perform a self-defeating action and the impossibility of performing that action.

The grandfather paradox (and all the time-travelling paradoxes built around self-defeating actions) is canonically spelled out in terms of abilities: if time travel is possible, then Tim both has and lacks the ability to kill Gramps. We will present a slightly different version of the paradox, based on the agent's potentialities.[2]

1. Time travel is metaphysically possible. (TimeTravel)
2. If something has an iterated potentiality for it to be the case that *p*, then it is possible that *p*. (Possibility)
3. It is impossible for Tim to kill Gramps in 1922. (NoSelfDefeat)
4. In 1922 Gramps is an *F*, where *F*s are physical duplicates of Gramps.
5. In 2022 Tim has the potentiality to kill *F*s.
6. Tim retains his potentiality to kill *F*s upon time travelling.
7. In 1922 Tim has the potentiality to kill Gramps. (4, 5, 6)
8. It is possible for Tim to kill Gramps in 1922. (2, 7)
9. ⊥. (8, 3)

We take premisses 1–4 as unproblematic assumptions in the current dialectical context. Premiss 1 holds by hypothesis. Premiss 2 follows from adopting Dispositionalism. Note that premiss 2 rules out any solution involving the ability to do the impossible (Spencer 2017, Effingham 2020): accepting that there could be genuine potentialities to bring about the impossible (Jenkins

2 The two versions would be equivalent if abilities were just dispositions or potentialities. However, this is implausible (Vetter forthcoming, Vetter and Jaster 2017).

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and Nolan 2012) would simply falsify Dispositionalism – at least in its current form. As to premiss 3, we take Tim's murder of Gramps as an instance of a self-defeating action, and we take these to be metaphysically impossible, for performing these actions would bring about a contradiction. Thus Tim's attempted murder of Gramps is more problematic than any old attempt to change the past. Finally, premiss 4 is trivial: since *F* just is the property of having the same intrinsic physical properties as Gramps, Gramps is an *F*. In what follows we will often speak as if the potentiality to kill *F*s is an intrinsic property, that is, one that Tim could have regardless of being accompanied or alone. Compare it with the intrinsic potentiality of a key to open a lock of shape *T*, as opposed to the extrinsic potentiality to open *that specific lock* (Molnar 2003: 102–11). The commitment is not vital: it is part of the set-up of the relevant time-travelling cases that all the extrinsic conditions obtain (see §3). We just need to ensure that Tim possesses and retains whatever intrinsic potentiality of his that grounds the potentiality to kill *F*s. We think that premisses 5 and 6 are highly intuitive, but will require a more substantial justification nonetheless. We turn to these in the next two sections.

3. *Justification of premiss 5*

We think that premiss 5 ('In 2022 Tim has the potentiality to kill *F*s', where *F*s are physical duplicates of Gramps) is intuitive and prima facie plausible. Both Gramps and Tim are ordinary human beings. This means, unfortunately, that Tim has the potentiality to bring deadly harm to other human beings, including those that are physically just like Gramps (who is not special in that regard). The burden of proof should be on those who want to deny the premiss. We will justify premiss 5 by considering and rejecting what strikes us as the best objection against it.

The argument to deny premiss 5 proceeds in two steps. The first step is to note that the premiss is not *specific enough*: we can consider the potentiality to kill *F*s as a determinable, grounded in more temporally determinate properties, such as the potentiality to kill *F*s-in-2023, or the potentiality to kill *F*s-in-1922. The second step is to concede that Tim has the determinable property (as it is intuitive), but lacks the right determinate property that would spell trouble for the time-travelling case. For instance, we could avoid the inconsistency if we could maintain that:

(a) At 2022, POT[kill-*F*s](Tim).
(b) At 2022, POT[kill-*F*s-in-2023](Tim).
(c) Not: At 2022, POT[kill-*F*s-in-1922](Tim).

Thus, even if we grant that all potentialities are retained upon travelling to the past (premiss 6), in 1922 Tim would not have the potentiality to kill *F*s, since he did not have that potentiality in 2022 in the first place.

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Vetter (2015) offers some reasons to accept the second step of the argument. She argues that, generally, potentialities are future oriented; the only past-directed potentialities we have are those that have actually been exercised. That means that '[w]e have no potentialities for the past to have been different, though we have the potentialities for the past to have been just as it was' (2015: 189). So, assuming that Tim did not kill *F*s in 1922, one might think that Tim in 2022 does not have any potentiality to kill *F*s in 1922.

We do not think that the argument against premiss 5 is successful. In particular, the first step of the argument rests on a misunderstanding of how potentialities ground 'dated truths'. The objection presupposes that potentialities ground dated truths such as 'the sugar dissolves at 12.00', 'Tim kills Gramps in 1922' etc. by pointing towards a temporally specific manifestation, that is, POT[dissolves-at-12.00], POT[kills-in-1922] etc. In short, it assumes:

(DatedManifestations) Potentialities ground dated truths in virtue of being directed to a dated manifestations.

We have argued elsewhere (Giannini and Donati MS) that this is the wrong account for dated truths and the temporal asymmetry of potentialities – there are no such things as fine-grained dated manifestations, such as those appearing in (b) and (c). There are only generic manifestations (and hence generic potentialities) such as (a). We rehearse some of the arguments only very briefly here: (i) DatedManifestations leads to an unacceptably profligate ontology: each dated truth would correspond to a specific dated manifestation. This, in turn, entails a corresponding multiplication of potentialities. This is because a power's identity is fixed (at least partially) by its manifestation (Bird 2007, Vetter 2015). Since the dated manifestations are distinct, so are the potentialities that bring them about. Thus, to each dated manifestation there corresponds a specific property: POT[dissolves at 10](sugar) ≠ POT[dissolves at 10.01](sugar). (ii) DatedManifestations is in tension with some of the most credible accounts of the nature of manifestations, for not all manifestations can be the sort of entity that is dated.[3] Consider, for instance, Tugby's (2013) proposal that manifestations are Platonic universals. Platonic universals are absolutely independent entities. If they encoded information about temporal whereabouts (e.g. the property of breaking at 3.45), then some (spatio)temporal point would be part of their essence. But, if so, they would *depend upon* that spatiotemporal point, leading to a contradiction. These incompatibilities are a cost: ruling out some of the most credible accounts of the metaphysics of properties for powers is not a welcome result.

3 There might be other tensions: the strategy is likely to be incompatible with relativism about spacetime (or views that spacetime is contingent).

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Instead, dated truths should be accounted for without dated manifestations, by invoking the following elements:

(I) A potentiality directed at some (generic, non-dated) manifestation
(II) The time of activation of the potentiality
(III) A duration fact: a fact that specifies how long it takes a certain potentiality to bring about its manifestation since its activation

Consider a vase that has the generic potentiality to break, which is activated at time t (when e.g. the vase is hit with a hammer). If there is a fact to the effect that the potentiality to break brings about its manifestation by unfolding over an interval Δ,[4] then the potentiality's activation at t is enough to make true the dated claim 'possibly, the vase breaks-at-t^*', where $t^* = t + \Delta$.

Crucially these elements line up perfectly in the case of time travelling, while preserving Vetter's point that there is a temporal asymmetry with respect to potentialities. Potentialities are forward looking in that it takes some time for them to unfold and bring about their manifestation, so ordinarily the only potentialities that we have will concern the future. But, of course, if one travels back in time, the process will unfold *in the past,* while in a sense they keep unfolding forward. Thus we do not need to accept temporally fine-grained facts such as (b) or (c), let alone distinguish between those that Tim has and those that he has not. All we need is the generic power (a). Assume that the minimal duration of the process of killing *F*s is Δ. Thus it will follow that x can kill an F at time t iff x has exercised their power to kill *F*s at an interval as long as Δ before t. And this can easily be granted in our case: Tim goes back far enough that the putative date of Gramps' death is well ahead, beyond the minimal duration of the killing process. And this is all we need to accept premiss 5.

4. *Justification of premiss 6*

Premiss 6 states that Tim retains his potentiality to kill *F*s upon time travelling. Tim's potentiality to kill Gramps is not a fundamental property. Rather, it is grounded in some complex arrangement of more basic powers. Ultimately these will boil down to his fundamental physical properties, appropriately structured. Tim does not lose his fundamental physical properties when time travelling. This is because his fundamental potentialities *have been exercised in the past*. Tim in 1922 was a massy body which interacted with other physical entities, not some sort of ghost. Therefore he has made a causal difference to the Earth's gravitational field. To do that, the mass-related potentialities were being exercised. And one can only exercise the potentiality that one has.

4 For reasons of space, we cannot offer an argument in favour of the existence of these duration facts here: see Giannini and Donati MS.

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The same applies to the other fundamental potentialities. What about their arrangement? We can simply stipulate that, upon travelling, their internal organization remains unchanged: surely it is possible that Tim's earliest temporal part in 1922 has the same internal structure as his latest 2022 temporal part. So, given that Tim's potentiality to kill *F*s is grounded in his more fundamental properties, appropriately structured, we must conclude that it is at least possible that Tim retains his potentiality to kill *F*s upon time travelling.[5] And this is all we need to set the paradox off. In short:

(IV) In 2022 Tim's fundamental powers and internal structure ground Tim's potentiality to kill *F*s.
(V) In 1922 (at least some of, but likely all of) Tim's fundamental powers are exercised.
(VI) Therefore in 1922 Tim must have retained his fundamental powers.
(VII) Tim-in-1922 has the same arrangement of fundamental powers as Tim-in-2022.
(VIII) Therefore Tim retains his potentiality to kill *F*s.

The argument works if Tim's fundamental powers and his internal structure *fully* ground his potentiality to kill *F*s – that is, if this is an intrinsic property of sorts. But one could object that this is not the case: the potentiality to kill *F*s is *extrinsic* – for it to be instantiated, it demands more of the world than Tim alone can deliver – so the argument above is not sufficient. Fair enough. The problem is that, even conceding that the potentiality to kill *F*s is extrinsic, we have no reason to deny that Tim retains it in 1922. For what could be the non-intrinsic, partial ground of Tim's potentiality that is missing in 1922? It seems that the most plausible extrinsic partial grounds to POT[kill-*F*s] would be the laws of nature, the existence of *F*s or the presence of some other mutual disposition partner (Martin 2007, Williams 2019: chs. 3, 4) needed to bring about the killing of an *F* (i.e. the gun, the intention to kill etc.). But these elements are all in place in 1922. The laws of nature need not change upon time travelling. Gramps is an *F* and is standing right over there, so there is an *F*. And the set-up of the thought experiment establishes *ex hypothesi* that the *circumstances* are right – which means that all mutual disposition partners are there. What other extrinsic element could be missing, to ensure that Tim does not retain his potentiality? We submit that nothing is missing – hence in 1922 Tim still has the potentiality to kill Gramps.

5. *Justification of the inference*

The last option to resist the argument is to reject the inference from premisses 4–6 to premiss 7, that is, deny that only because in 1922 does Tim have

5 We do not need to assume that grounding is necessary: the paradox works if there is at least one possible world where he retains his grand-patricidal powers.

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the potentiality to kill *F*s, and Gramps is an *F*, then Tim has the potentiality to kill Gramps. To our eyes, the most plausible way to do so is along these lines:

> In 1922 Gramps is an *F* and Tim has the potentiality to kill *F*s; however, Gramps also has some further property *G*, such that Tim does not have the potentiality to kill *F*s-that-are-*G*s. In this case, *G* might simply be the property of *not being killed by Tim in 1922*. So Tim does not have the potentiality to kill Gramps after all, and thus it is not possible for him to do it: contradiction avoided.

This is just an attempt to adapt the Lewisian strategy to avoid the potentiality paradox. For Lewis (1976), an agent *can* Φ (and similarly Φ-ing is possible for them) only *relative to a class of compossible facts*. Thus killing Gramps is possible for Tim relative to a set of facts like {Tim has a gun, Tim wants to kill Gramps, …} but not possible relative to the wider set of facts {Tim has a gun, Tim wants to kill Gramps, Gramps did not die in 1922, …}.

The problem is that potentialities are not like that. Given Dispositionalism, neither are possibilities. The Lewisian strategy cannot be applied here. Potentialities are *localized* (Vetter 2015: 2–10). They concern how a particular entity is; they do not depend on how the whole world around them is. That is, something can have a potentiality *simpliciter*, and not relative to a set of facts – hence considering a wider set of facts or properties (e.g. future facts) does not affect whether an entity has a certain potentiality or not.[6]

Locality is a crucial fact about potentialities, which cannot be readily dismissed. It is the feature that allows powers theorists to make sense of disposition ascriptions where potentialities are masked, and the ability to make sense of masked potentialities is one of the crucial advantages that irreducible potentialities have over the reductive accounts of dispositions (Bird 1998, Molnar 2003, Vetter 2015). Consider the case of a fragile vase: it has the disposition to break (if struck with light force). Now consider a mask: the vase is safely packaged in polystyrene foam. The system constituted by the vase and the polystyrene foam is *not* disposed to break if struck with light force; the related counterfactual 'were I to hit the vase with light force, it would break' is false. Yet masks do not remove the potentiality they mask: the vase remains fragile. The counterfactual analysis of dispositions fails to make sense of masks because counterfactuals are sensitive to what goes on in the wider environment (indeed in the whole world), and this does not line up with our intuition that the vase is still fragile and retains its potentiality to break.

6 A reviewer suggested that the view that certain potentialities are intrinsic might create widespread problems about past-concerning possibilities in general. This deserves further investigations, which unfortunately we cannot carry out here. However, there are reasons to think that time-travel cases are special: this is because these are not trivial past-directed potentialities. Since the time traveller travels back in time, their potentialities are not constrained by Vetter's (2015: 189–90) Triviality principle.

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Just like the vase's fragility, Tim retains the potentiality to kill *F*s, even if Tim does not have the potentiality to kill *F*s-that-are-*G*s. Since Gramps is an *F* and a *G*, he is also just an *F* – and Tim *does* have the potentiality to kill *F*s. Gramps's being a *G* might *mask* Tim's potentiality to kill *F*s, in a way that Tim's potentiality will not get manifested, but it does not *remove* it. Crucially, if Dispositionalism maintains that *x* having a potentiality to *Φ* is a *sufficient condition* for it to be possible that *x Φ*s, then this is enough to fully ground that it is possible for Tim to kill Gramps.

6. *Time travel and perfect masks*

Normally, the fact that masks do not eliminate the underlying potentiality, and the corresponding possibility claim remains true, is not a problem: the vase packed in polystyrene foam *can still break*, even though not 'here and now': we can remove it from the packaging, or the packaging might not be enough to save the vase in any case. A serious problem arises, however, when the masks are both perfect, that is, 'something which, whenever it is present, makes the manifestation of our disposition impossible' (Vetter and Busse 2022) and necessary, that is, nothing has a potentiality to remove the mask. For, in this case, we have a potentiality that cannot be manifested – generating both a possibility and an impossibility.

The impossibility of carrying out self-defeating actions is, then, a necessary perfect mask of sorts; and the possibility of time travel, coupled with the fact that ordinary potentialities seem to be carried back in time, is what allows one to smuggle a potentiality under the mask, as it were. It is tempting, therefore, to seek out a resolution to the potentiality-based grandfather paradox that is in line with one's overall preferred strategy to tackle the issue of necessary perfect masks.

Setting aside the option of simply abandoning Dispositionalism, there are two broad strategies. Either one modifies the metaphysics of potentiality or Dispositionalism in a way that prevents the conflict – for instance, abandoning the idea that potentialities are localized, or offering a more sophisticated account of how simple component potentialities interact with complex ones – or one finds a way to eliminate the necessary perfect masks. Both options are costly, but perhaps ultimately viable.

The first option is prima facie unappealing: thinking that one must look *beyond* the dispositional property to know whether there is a corresponding possibility undermines the entire dispositionalist framework: either (i) we would have to admit that potentialities only partially ground modal facts, and the full grounds involve something more or (ii) we would have to look at the potentialities of the whole world. Both are borderline unacceptable for the dispositionalist. It is clear that (i) amounts to abandoning Dispositionalism, at least in its canonical form. As to (ii), if the grounds of possibility were not localized, and we have to know how the world is as a whole before being

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able to know any modal facts grounded in potentiality, then it seems that Dispositionalism loses much of its appeal in the epistemology of modality (Mumford and Anjum 2011, Vetter 2015, 2016, 2020).

But the other strategy, namely eliminating the necessary perfect masks, seems to be just as costly and unappealing. The necessary mask can be eliminated in two ways: either by (i) removing the masked power or by (ii) removing the mask (or showing that it is not perfect or necessary after all). Removing the masked power means either rejecting premiss 1 and declaring time travel to be impossible, or showing that potentialities do not travel back in time, contra our arguments above. It strikes us that neither is appealing: our best science seems to allow for the possibility of time travel – hence, a fortiori, for its metaphysical possibility – so there seems to be good reason to accept premiss 1, and we hope that our arguments above are sound and convincing. This leaves us with the last option: removing the perfect mask. This would mean showing that killing one's own grandfather, auto-infanticide and other self-defeating actions are not impossible after all, thus rejecting premiss 3. This is perhaps the most viable option, but it strikes us as costly nevertheless.[7]

7. *Conclusion*

We have presented a potentiality-based version of the grandfather paradox, and argued that it is much harder to dispel for the dispositionalist. Indeed, we suggested that time travel is an instance of a necessary perfect mask – Dispositionalism's 'big, bad bug' (Vetter and Busse 2022) – to which there does not seem to be a painless solution.[8]

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7 Perhaps this can be done by adopting a two-dimensional model of time (see e.g. van Inwagen 2010, Bernstein 2017).

8 We would like to thank Raoni Arroyo, Eilidh Beaton, Sara Bernstein, Simone Gozzano, Dave Ingram, Giorgio Lando, Adam Lovett, Chiara Martini, Pedro Merlussi, Stephen Mumford, Lewis Ross, Matthew Tugby, Michael Wallner and two anonymous reviewers for their questions, suggestions and helpful feedback. We would also like to thank audiences at Campinas, Exeter, Durham and the 2022 Joint Session.

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