



The harmony of grounding

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Abstract Mereological harmony is the idea that the mereological structure of objects mirrors the mereological structure of locations. Grounding harmony is the idea that there is a similar mirroring between the grounding structure of objects and locations. Our goal in this paper is exploratory: we introduce and then explore two notions of grounding harmony: locative and structural. We outline potential locative and structural harmony principles for grounding, and show which of these principles may entail, or be entailed by, principles of mereological harmony. We then present a case study in grounding harmony, by applying it to Schaffer’s (in *Philos Rev* 119(1):31, 2010a) specific version of priority monism. We show that, given a strong form of grounding harmony, Schaffer-style monism is inconsistent, but that this inconsistency can be resolved by offering bespoke notions of grounding harmony. We use Schaffer’s priority monism to demonstrate a broader tension within certain packages of metaphysical views, including versions of priority pluralism. We close by briefly considering the case against structural grounding harmony.

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1 Introduction

Mereological harmony is the idea that the mereological structure of objects mirrors the mereological structure of locations. Grounding harmony is the idea that there is a similar mirroring between the grounding structure of objects and locations. There are two different versions of grounding harmony: *locative* grounding harmony and *structural* grounding harmony.

Locative grounding harmony is the straightforward idea that the grounds and the grounded must share a location in some sense. Structural grounding harmony is *perhaps* a little more complex: it is the idea that the grounding structure of objects is mirrored in the grounding structure of locations. Structural grounding harmony is thus the grounding analogue of mereological harmony.

We can get a feel for structural grounding harmony with a quick example. Suppose that a cat is grounded in each of its parts (collectively): head, legs, tail, core, and so on. Further, suppose that (for instance) a leg of the cat is grounded in the upper limb, lower limb and paw. In that case, we can say that this is an instance of grounding harmony if the location of the paw, lower limb and upper limb themselves ground the location of the cat's leg, which itself partially grounds the location of the cat. For, if all of those conditions are satisfied, then the grounding structure of the object (the cat) is mirrored in the grounding structure of the locations it occupies.

While there has been much written on mereological harmony (see, for instance, Donnelly (2004), Varzi (2007), Uzquiano (2011), Saucedo (2011)), there has been virtually no consideration given to structural grounding harmony, and little written about locative grounding harmony. The purpose of this paper is to motivate and then lay the groundwork for a larger discussion of structural grounding harmony in particular. Although our primary focus is on structural grounding harmony, we will briefly consider locative grounding harmony along the way.

We begin, in Section Two, by considering two motivations for taking structural grounding harmony seriously within metaphysics. In Section Three we outline a range of putative principles of grounding harmony before, in Section Four, showing how to derive a structural grounding harmony principle from the combination of mereological harmony and locative grounding harmony. In Section Five we then present a case study, the purpose of which is to provide a concrete example of how structural grounding harmony may be used. We show that a principle of structural grounding harmony can be used to derive an inconsistency within certain metaphysical positions. To show this, we use Schaffer's approach to priority monism as our stalking horse. However, our goal is not to defeat priority monism in any form; instead, we use monism as a test case for illustrating the kind of work that structural grounding harmony can do in metaphysics. We thus use the discussion of Schaffer's priority monism to demonstrate a general problem, one that afflicts versions of priority pluralism as well. Finally, in Section Six, we consider some objections to the idea that grounding obeys structural harmony principles.

2 Motivating structural grounding harmony

As we see it, there are two reasons to carry out a metaphysical investigation of structural grounding harmony. First, structural grounding harmony follows from other metaphysical commitments. Most notably, it follows from a commitment to supersubstantivalism. Supersubstantivalism involves two claims: (a) substantivalism about spacetime and (b) material objects are identical to spacetime regions (namely those regions that exhibit certain properties). Since material objects just *are* regions of spacetime, the location relation is just identity and whatever grounding structure objects have *must* be the grounding structure of locations. Supersubstantivalism thus recommends a very strong picture of structural grounding harmony indeed.

Another metaphysical commitment that leads to structural grounding harmony is a commitment to mereological harmony. As noted, mereological harmony is the idea that the mereological structure of objects reflects the mereological structure of locations. So, for instance, according to one principle of mereological harmony, *x* is part of *y* iff *x*'s exact location is part of *y*'s exact location. If we further assume that mereological relations imply grounding relations, in the sense that if *x* is part of *y* then *x* grounds *y*, then mereological harmony appears to imply structural grounding harmony, since the grounding relations between parts and wholes are likely to mirror the grounding relations between their locations (via the mirroring of the associated mereological relations). The claim that mereological relations imply grounding relations is advocated, in some form, by Paul who endorses the 'composition intuition'. Here's Paul:

I hold that there is a world built from more fundamental constituents, and that the building relation is composition: the world is built by mereologically fusing its constituents. The *composition intuition*, as we may call it, is based on the thought that we enjoy a direct grasp of the nature of proper parthood (or perhaps we enjoy a direct grasp on the nature of composition) that makes a compositional approach to world-building superior to any other sort of approach. (Paul, 2012, pp. 221–222)

According to Paul, the connection between the more fundamental and the less fundamental—the connection that grounding is supposed to capture—is composition. As we will show a bit later on, mereological harmony does indeed imply structural grounding harmony when it is coupled to something like Paul's composition intuition.¹

¹ Why accept that grounding is mereologically mediated? Paul's suggestion is that such an account is *intuitive*. If she's right, then structural grounding harmony is motivated by the same intuitions. She actually goes a bit further than this and suggests that the notion of 'building' which takes us from the more fundamental to the less may be analytically tied to the notion of 'fusing'. Thus, in so far as we have evidence that our world is built, we have evidence that grounding is mereologically mediated via the analytic connection in question.

Note that Paul's version of the composition intuition is quite strong. But, as we will see, even a weaker form of the idea leads to structural grounding harmony (via mereological harmony), so long as one is willing to accept some form of locative grounding harmony as well. The weaker form of the idea is that grounding is mediated by mereological relations (i.e., every case of grounding operates through a mereological relation at some point, even if not all cases of grounding are strictly identical to mereological relations). So, if one finds Paul's general approach convincing, but not her specific version of the composition intuition, one may still have good reason to adopt some form of structural grounding harmony, given a commitment to mereological harmony.²

Even if one does not take grounding to be mereologically mediated, it is quite common to take mereological relations to imply grounding relations. Since, as we shall see, there are various logical connections between mereological harmony and grounding harmony, the connection between grounding and mereology thus promises to transport harmony from one domain to the other. More generally, the nature of the relationship between grounding and mereology appears to turn on the extent to which each might be a harmonious relation, and what kind of harmony principles might be appropriate in each case.

This brings us to the second motivation for investigating structural grounding harmony. Whereas the first motivation focuses on reasons to believe that grounding obeys structural harmony, the second motivation focuses on the work that structural grounding harmony can do within metaphysics.

As before, there are two cases to consider. The first case involves supersubstantialism again. Suppose one has independent reason to accept structural grounding harmony (say, because one accepts Paul's composition intuition along with one or more principles of mereological harmony). Now, consider the kinds of arguments that Schaffer offers for supersubstantialism (2009). These have a general form: if supersubstantialism is false, then there is some metaphysical correlation—namely the correlation between the mereological structure of objects and the mereological structure of locations—that is left unexplained. Suppose then that spacetime regions and material objects are not identical and that the grounding structure of objects nonetheless mirrors the grounding structure of locations (i.e. grounding obeys structural harmony). Such a correlation is *prima facie* in need of explanation. If supersubstantialism is true, then an explanation is provided; not so for a dualism of location and object. Thus, one reason to endorse supersubstantialism follows from a commitment to structural grounding harmony. Given such a commitment, supersubstantialism renders the world a bit less mysterious.

² Depending on how one feels about intuitions in metaphysics, one may not be all that swayed by Paul's composition intuition. While we don't wish to be drawn into a debate about whether the composition is true, we will note another potential motivation for Paul's view. Paul's picture is a pleasingly elegant and unifying picture of reality. On Paul's view, all metaphysical structure is induced by a single relation: composition. While elegance and unification are, at best, *pro tanto* goods, they are still goods worth having, and may tip the scales in favour of something like at least [WMMG].

The second case involves certain views about priority and fundamentality. This case is more involved, however, and requires a better understanding of structural grounding harmony. And so, we defer full discussion until Section Four. There we show that at least some principles of structural grounding harmony are inconsistent with certain metaphysical accounts of reality. In particular, any view on which the grounding structure of locations is uniform (moving from, say, whole to part or vice versa in every case) while the grounding structure of objects is non-uniform (say moving from part to whole in some cases and not others) will generate a conflict between structural grounding harmony and grounding itself. We give one example of the conflict for a specific package of views centred around Schaffer's version of priority monism. This is especially interesting since Schaffer is also a supersubstantialist. The very kind of structural grounding harmony that seems to follow from supersubstantialism, however, is the kind of harmony that conflicts with his take on priority monism. So, it is not just that Schaffer's priority monism is at odds with structural grounding harmony; it may also be at odds with supersubstantialism *because* of structural grounding harmony. This interplay between structural grounding harmony and supersubstantialism is intriguing, and all the more so once it is realised that the conflict is not limited to monism: certain forms of priority pluralism can be brought into conflict with supersubstantialism in the same way.

3 Locative and structural grounding harmony

In this section we will introduce a range of principles of grounding harmony, before exploring the logical relationships between such principles and principles of mereological harmony. This will help us to make good on the claim made above regarding the connection between mereological harmony, Paul's composition intuition and structural grounding harmony. It will also lay the groundwork for our detailed look at Schaffer's priority monism in Section Four. As noted, we will look at both locative and structural grounding harmony principles. We do this because locative grounding harmony has a role to play in our derivation of structural grounding harmony from mereological harmony.

3.1 Preliminaries

We will begin with some preliminaries. First, a bit on how we conceive of grounding. We will assume that grounding is a relation of relative fundamentality, which generates ontological structure.³ The formal features of grounding have been widely discussed, with many (but by no means all) supposing it to be a strict partial

³ We therefore assume the view that grounding is a relation that obtains between facts. Further work may be needed to extend the harmony picture that we outline in this paper to what is sometimes known as the operator view, on which grounding is an operator or sentential connective that connects sentences or propositions.

order, i.e., an asymmetric,⁴ irreflexive,⁵ transitive,⁶ relation.⁷ The relata of grounding relations are commonly taken to be facts, conceived as worldly entities comprised of objects, properties, and relations, in a structured manner.⁸ For simplicity, in this paper, we will simply talk of *entities* as the relata of grounding, where these can be construed as facts, or as objects, or as states of affairs. But nothing we say hangs on this choice.

We will adopt a standard distinction between partial and whole or full grounding. Very roughly, x fully grounds y when x is a ground of y and x , on its own, is sufficient for y . By contrast, x partially grounds y when x is a ground of y and x , on its own, is not sufficient for y . We will use the symbol ‘/’ to denote full grounding, as in $x/y = x$ is a full ground of y . We will use the symbol ‘//’ to denote partial grounding, as in $x//y = x$ is a partial ground of y . Where we need to talk of some plurality grounding some entity, or plurality of entities, we will explicitly talk of the xxs or the yys .⁹ Note that when we do, we will be treating full grounding as a non-distributive predicate. Thus, if the xxs ground y , then that means that the xxs *together* fully ground y , but none of the xxs on its own fully grounds y . Partial grounding, by contrast, is a *distributive* predicate. Thus, when we say that the xxs are partial grounds of y , we mean that each z in the xxs is a partial ground of y .

In addition to a notion of grounding, we need a notion of location. We take, as our locative primitive, exact location. Following Gilmore (2007), we take exact location to be a relation $L(x, y)$ between an object x and a region y . We thus assume that x is exactly located at y when y shares the same size and shape as x and stands in the same spatiotemporal relations to other objects as x does. We assume that spatiotemporal regions can stand in various relations to one another, including the relation of sub-regionhood and proper sub-regionhood. We will interpret the structure of locations mereologically. Thus, sub-regionhood is parthood; proper sub-regionhood is proper parthood and overlap between regions is mereological overlap (i.e., sharing a part in common).

⁴ See *inter alia* Schaffer (2009), Cameron (2008), Trogdon (2013a), Audi (2012a; 2012b), Bennett (2017) and Rosen (2010).

⁵ Fine (2012), Schaffer (2009), Audi (2012a) and Raven (2015) think that metaphysical explanation is irreflexive.

⁶ Schaffer (2009), Cameron (2008), Audi (2012a, 2012b) and Raven (2012).

⁷ The formal features of grounding are controversial. Some are inclined to add non-monotonicity to the list (See Schaffer (2009), Audi (2012a), Cameron (2008), Trogdon (2013), Raven (2012; 2015) and Duncan, Miller & Norton (2017)). While others are inclined to deny that grounding is asymmetric, irreflexive and transitive. For instance, Rodriguez-Pereyra (2015), Bliss (2014; 2018), Barnes (2018) and Thompson (2016) have argued that there are symmetric instances of grounding, and thus that grounding is merely non-symmetric. Rodriguez-Pereyra (2015), Bliss (2018) and Jenkins (2011) deny that grounding is irreflexive. Schaffer (2012) and Litland (2013) reject transitivity.

⁸ Not all theorists restrict the relata of grounding to facts. See Schaffer (2009) and Cameron (2008).

⁹ We thus don't intend this to prejudge issues about the adicity of the grounding relation. If one thinks that grounding is instead many-one, or many-many, (see Dasgupta 2014) or variably polyadic, (Fine 2012) one can read one or both of x and y as always referring to pluralities of entities.

Given this mereological overlay, we can then use exact location to define a notion of weak location in the standard way, using exact location and the mereological relation of overlap (cf. Parsons (2007)).

$$WKL(x, y) =_{df} \exists z [L(x, z) \& O(z, y)]$$

For reasons that will become clear a bit later on, the mereology we will use throughout this paper takes proper parthood ‘ $<$ ’ as the primitive notion of parthood. As with grounding, we allow that pluralities, the xxs , can enter into the proper parthood relation. Thus, $xx < y$ means that the xxs are proper parts of y . We view ‘ $<$ ’ as a distribute predicate, like partial grounding. Thus, if $xx < y$ then each z in the xxs is a proper part of y . Proper parthood is defined via the following axioms, which turn it into a strict partial order (like grounding):

1. $\forall x(x \not< x)$ [Irreflexivity]
2. $\forall xy(x \leq y \rightarrow y \not< x)$ [Asymmetry]
3. $\forall xyz((x \leq y \& y \leq z) \rightarrow x \leq z)$ [Transitivity]

Using proper parthood as our mereological primitive, we can then define up a number of mereological notions, including the following:

1. $x \leq y =_{df} x \leq y \vee x = y$ [Parthood]
2. $x \circ y =_{df} \exists z(z \leq y \& z \leq x)$ [Overlap]
3. $x \circ_p y =_{df} \exists z(z \leq y \& z \leq x)$ [Proper Overlap]
4. $x \cup y =_{df} \exists z(x \leq z \& y \leq z)$ [Underlap]
5. $x \cup_p y =_{df} \exists z(x \leq z \& y \leq z)$ [Proper Underlap]

3.2 Grounding harmony principles

With grounding, exact location and proper parthood in hand we are now in a position to outline some principles of grounding harmony. As noted in Section One, there are two kinds of grounding harmony. The first is locative grounding harmony, which imputes a relationship between grounding and location, of the following general kind: if x grounds y or vice versa, then x and y share a location in some sense. The second is structural grounding harmony, which requires that the grounding structure of objects reflects the grounding structure of locations. Let us focus, first, on locative grounding harmony.

Locative grounding harmony can be captured by principles of two broad kinds: conditional and unconditional principles. Conditional principles make grounding harmony conditional on the fact that the grounds and the grounded have locations. Unconditional principles say that the grounds and grounded must share a location. Clearly, conditional principles are more permissive than unconditional ones, since they don’t force grounding to only obtain between located objects.¹⁰ For present purposes, we will focus on unconditional principles. Conditional principles are easy

¹⁰ For instance, in models where sets are taken to be abstract and grounded in their physical members such conditional principles may be useful.

to formulate: simply take each unconditional principle and make it the consequent of a conditional, the antecedent of which is that the grounds and the grounds are located (in whatever sense is relevant).

Given that we have different notions of grounding in play (whole or partial), different notions of location in play (exact and weak), and different ways for locations to relate to one another based on the mereological notions defined above, there are many different candidate principles for locative grounding harmony. These principles fall into two broad families, depending on whether the notion of location at issue is exact or weak. Below are some potential principles of locative harmony. Note that weak principles can be formulated simply by replacing ‘exact’ for ‘weak’ location in each principle. As will become clear in §3.5, we need some of these principles to bridge from mereological harmony into structural grounding harmony. We also need certain principles to draw out some of the metaphysical implications of structural grounding in §4. However, in general, we offer the below principles in an exploratory mood.

[LG1]Exact Co-location: If x/y then x 's exact location = y 's exact location.

[LG2]Exact Partial Co-location: If $x//y$ then x 's exact location is a proper part of y 's exact location.

[LG3]Exact Containing Grounded: If x/y , then y 's exact location is a part of x 's exact location.

[LG4]Exact Partial Containing Grounded: If $x//y$ then y 's exact location is a proper part of x 's exact location.

[LG5]Exact Containing Grounds: If x/y , then x 's exact location is a part of y 's exact location.

[LG6]Exact Partial Containing Grounds: If $x//y$ then x 's exact location is a proper part of y 's exact location.

[LG7]Exact Overlap: If x/y , then x 's exact location and y 's exact location overlap.

[LG8]Exact Partial Overlap: If $x//y$, then x 's exact location and y 's exact location overlap.

[LG9]Exact Partial Proper Overlap: If $x//y$, then x 's exact location and y 's exact location properly overlap.

By mooted these locative grounding harmony principles we mostly hope to spark further discussion. We expect there to be many more principles that aren't on the list. For the most part, however, we won't try to sort through the principles of locative harmony here. That being said, there are certain motivations that might speak for or against specific principles on the list, which are worth briefly considering.

One important motivation for some kind of locative grounding harmony concerns the notion of “grounding at a distance”. Grounding at a distance can occur when x grounds y and x 's exact location is disjoint from y 's exact location. Grounding at a

distance might also occur when the *xxs* fully ground *y*, but *y*'s exact location is disjoint from the fusion of the exact locations of the *xxs*. If one wishes to rule out both kinds of grounding at a distance, then one will probably need at least [LG3] and perhaps even principles as strong as [LG1] or [LG2]. Avoiding grounding at a distance may be particularly important for those who see a deep connection between grounding and causation. Wilson (2018), for instance, argues that grounding and causation are both types of 'metaphysical causation'. Schaffer (2016) holds a similar view, maintaining that there is a very strong analogy between causation and grounding. Causation, however, seems to preclude causal action at a distance. That being so, a ban on grounding at a distance may be necessary to preserve the connection between grounding and causation. It could also constitute a point of difference between the two notions, depending on how causal action at a distance is to be understood (see Baron et al. (2020) for a suggestion along these lines).

Other metaphysical positions speak for or against specific locative harmony principles in the same way. For instance, if one endorses supersubstantialism, then one is likely to reject [LG1]. For the supersubstantialist, objects are identical to their locations. Accordingly, if *x* grounds *y*, and *x*'s location is identical to *y*'s, then it follows that something grounds itself. This violates the irreflexivity of grounding and so, insofar as one aims to preserve that particular formal feature, one should not endorse anything as strong as [LG1]. Similar considerations may motivate [LG1] if, for instance, one is looking for a way to reject supersubstantialism.

Similarly, if one endorses Paul's composition intuition along with principles of mereological harmony, then principles like [LG2] seem attractive, since they will better serve the relationship between mereology and grounding. A principle like [LG4], by contrast, is likely to violate mereological harmony principles that generally require the location of the part to be a part of the location of the whole ([LG4] plus the composition intuition would imply that the location of the whole is part of the location of the part).

There is much more to say about locative grounding harmony, and about the motivations that might lead one to endorse one or more of the above principles.¹¹ We will return to say a bit more about locative harmony below, laying bare its connection to mereological harmony (thereby giving some sense of how someone attracted to Paul's composition intuition and mereological harmony might think about locative grounding harmony). As noted, however, our focus in this paper is largely on structural grounding harmony, and so we will leave a deeper consideration of locative grounding harmony for another time.

This brings us to the principles of structural grounding harmony. As before, we can divide these principles into exact or weak principles, depending on the operative notion of location. Below are some candidate exact principles. Weak principles can be formulated by trading 'exact' for 'weak' location in each principle, and conditional forms of the structural grounding principles can be formulated as above, by making each principle conditional on grounds and grounded having a location.

¹¹ We are grateful to an anonymous referee for identifying the three motivations discussed above for specific principles of locative grounding harmony.

As before, these principles are offered in an exploratory mood in the first instance. Some of these principles we will explicitly use in §3 and, again, in §4, where we will see why one might be minded to reject [SG2] in particular. However, there is nothing particularly special about the list below, it is just a guide to the kinds of principles of structural grounding one might endorse.

[SG1] Exact Full Structure: x / y iff x 's exact location grounds y 's exact location.

[SG2]Exact Partial Structure: $x // y$ iff x 's exact location partially grounds y 's exact location.

[SG3]Exact Full Overlap: x / y and x / z iff x 's exact location grounds both y 's exact location and z 's.

[SG4]Exact Partial Overlap: $x // y$ and $x // z$ iff x 's exact location partially grounds both y 's exact location and z 's.

3.3 Mereological harmony and grounding harmony

Having outlined a range of harmony principles for grounding, we will now explore the deductive relationships between principles of mereological harmony and principles of grounding harmony. We do this for two reasons. First, the connection between grounding harmony and mereological harmony is important for motivating grounding harmony more generally. For instance, as noted, a connection between mereological harmony and Paul's composition intuition is supposed to motivate structural grounding harmony. Second, the connection between mereological harmony and grounding harmony will play a role in our exploration of structural grounding in §4 and so it is important to first explore that connection in a bit of detail. Note that we won't show how to derive every grounding harmony principle stated above (or indeed, that there might be) from some principle of mereological harmony. What we do in this section is indicative only, designed to give a flavour for the broad connection between the two types of harmony.

In order to connect mereological harmony to grounding harmony, we need two things: principles of mereological harmony, and principles that connect mereology to grounding. First, some principles of mereological harmony. As with principles of grounding harmony, mereological harmony principles have exact and inexact forms. Here are some of the more common exact principles:

[M1] Parts: x is part of y iff x 's exact location is part of y 's exact location.

[M2] Fusion: x is a fusion of the y 's iff x 's exact location is a fusion of the exact locations of the y 's

[M3] Proper Proper Parts: x is a proper part of y iff x 's exact location is a proper part of y 's exact location.

[M4] Overlap: x overlaps y iff x 's exact location overlaps y 's.

[M5] Proper Proper Overlap: x properly overlaps y iff x 's exact location properly overlaps y 's.

As before, weak principles can be formulated by swapping 'exact' for 'weak' location.

Principles that connect mereology to grounding are generally based on the idea that at least some mereological relations are instances of grounding relations. Because grounding is a strict partial order and parthood is a partial order, it is not the case that all parthood relations are instances of grounding (that being said, one can define grounding as a partial order à la Fine (2012), which would bring the mereological and grounding cases closer together). Proper parthood, on the other hand, is a strict partial order, and so it is possible to take proper parthood relations to be instances of grounding. This suggests the following initial connection between grounding and proper parthood:

[C1] If $x < y$, then $x // y$.

Note that [C1] is acceptable even if parthood relations are not themselves instances of grounding, so long as every instance of parthood implies an instance of grounding. Note also that, at this point, we are merely suggesting the possibility of linking grounding and parthood in this way (or in any of the ways specified below). We won't assume these connections in what follows (in part because some of them might be considered 'anti-monist', which will pose a problem for our discussion of priority monism in §4).

In addition to [C1], we may want a second principle that reflects the following thought: the sum-total of proper parts for some object constitute a full ground for that object. If we take 'xx' to be a way of referring to the xxs then this idea can be stated as [C2]:

[C2] If $xx < y$ and there is no z such that $z < y$ and z fails to be among the x 's, then xx/y .

Recall that '<' is a *distributive* predicate, whereas '/' is a non-distributive predicate. What [C2] says, then, is that if the xxs are proper parts of y —where this means that each of the xxs is a proper part of y —and there is no z that is both a proper part of y and fails to be among the xxs, then the xxs *together* are a full ground of y . [C2] does *not* say that each of the xxs individually is a full ground of y (since that would be to treat '/' as a distributive predicate).

Using these connecting principles, it is relatively straightforward to forge a link between mereological harmony and locative harmony. We'll consider that link in both directions (mereological to grounding and back again) before considering the link between mereological harmony and structural grounding harmony.

3.4 Mereological harmony and locative grounding harmony

Given [C1]—[C2], one can derive locative grounding harmony principles from mereological harmony principles, in an attenuated sense. Specifically, one can derive conditional forms of those principles: principles that only apply in the

presence of a mereological connection between objects. So, for example, the following derivation goes through, which yields a conditional that has [LG2] in the consequent:

[1] If x is a proper part of y then x 's exact location is a proper part of y 's exact location. [M3]

[2] If $x < y$ then $x // y$ [C1]

Therefore,

[3] If x is a proper part of y then x is a partial ground of y only if x 's exact location is a proper part of y 's exact location.

A similar derivation holds for [M5] and [LG9].

It is possible to derive unconditional versions of locative grounding principles from mereological harmony, but only by strengthening the connection between grounding and mereology. The strongest form of the connection is this:

Strong Mereologically Mediated Ground [SMMG]: (i) $x // y$ iff $x < y$ and (ii) xx / y iff $xx < y$ and there is no z such that $z < y$ and z fails to be among the xx s.

As above, ' $<$ ' in SMMG is distributive, while '/' is non-distributive. What (ii) in SMMG says, then, is that the xx s together are a full ground of y , just when each of the xx s is a proper part of y , and there's no z that's a proper part of y that's not among the xx s.

SMMG demands that every case of grounding implies a mereological connection and vice versa. A weaker form of SMMG requires only the mereological mediation of grounding in the case of partial grounding. One way to state a weakened form of SMMG is just to drop the second conjunct:

Moderate Mereologically Mediated Ground [MMMGMG]: $x // y$ iff $x < y$

MMMGMG is just [C1] strengthened to a biconditional. An even weaker principle forges a more indirect link between grounding and parthood. The basic idea is that x is a partial ground of y just when x is a part of some full ground for y . This weakened principle can be stated as follows:

Weak Mereologically Mediated Ground [WMMGMG]: $x // y$ iff there is some z such that z / y and $x < z$.

We will have more to say about [SMMGMG], [MMMGMG] and [WMMGMG] later. For now, it is enough to note that it is possible to use principles of this kind to derive unconditional forms of locative grounding harmony principles from mereological ones. For instance, the following derivation holds:

[1] x / y iff x 's exact location is a proper part of y 's exact location. [M3]

[2] $x < y$ iff $x // y$ [SMMGMG]

Therefore,

[3] $x // y$ iff x 's exact location is a proper part of y 's exact location.

[3] is strictly stronger than [LG2] but implies it. A similar derivation holds for [M5] and [LG9].

Derivations hold in the other direction too, from locative grounding harmony to mereological harmony. These derivations don't generally require principles like [SMMG] and [WMMG], given that mereological connections imply grounding connections. For instance, the following derivation goes through:

[1] If $x < y$ then $x // y$ [C1]

[2] $x // y$ only if x 's exact location is a proper part of y 's exact location [LG2]

Therefore,

[3] If $x < y$ then x 's exact location is a proper part of y 's exact location [M3]
A similar derivation goes through for [LG9] and [M5].

[M2] can be derived if we make the following further assumption about fusions: y is a fusion of the xxs just in case the xxs are proper parts of y such that there is no z that is a proper part of y that is not among the xxs . This assumption does cohere with the way some are inclined to think of fusions—as mereological sums of all and only a particular group of objects—and so it has some merit. Given the connecting assumption, [M1] can be derived as follows:

[1] y is a fusion of the xxs iff $xx < y$ such that there is no z such that $z < y$ and z fails to be among the xxs .

[2] If $xx < y$ and there is no z such that $z < y$ and z fails to be among the xxs , then the xx / y

[3] xx / y only if the joint location of the xxs is equivalent to the location of y .

Therefore,

[4] y is a fusion of the xxs iff the joint location of the xxs is equivalent to the location of y .

On the assumption that the joint location of the xxs just is their fusion, [4] is equivalent to [M1]. The second premise of the argument is a slightly modified instance of [LG1] to handle the case of plural grounds.

3.5 Mereological harmony and structural grounding harmony

Mereological harmony can also be used to derive principles of structural grounding harmony. In the first instance—and as in the locative case—we can derive structural grounding harmony principles that are conditional on cases of parthood. For instance, the following derivation holds:

[1] $x < y$ iff x 's exact location is a proper part of y 's exact location [M3]

[2] If $x < y$ then $x // y$ [C1]

Therefore,

[3] If x is a proper part of y then x is a partial ground of y iff x 's exact location is a partial ground of y 's exact location.

The conclusion, [3], is a conditional with [SG2] in the consequent.

As was the case with locative grounding harmony, the unconditional versions of structural grounding principles can be derived from mereological harmony if an appropriate linking principle between mereology and grounding is assumed. For instance, if we assume [MMMG] then it is straightforward to derive [SG2] from [M3] as follows:

[1] $x // y$ iff $x < y$ [MMMG]

[2] $x < y$ iff x 's exact location is a proper part of y 's exact location [M3]

Therefore,

[3] $x // y$ iff x 's exact location partially grounds y 's exact location [SG2]

Clearly, the derivation holds if we swap [M3] and [SG2] and so we can also derive a principle of mereological harmony from a principle of strong grounding harmony. Since [SMMG] is strictly stronger than [MMMG] the same derivations hold for the stronger principle as well.

Is it possible to derive a strong grounding harmony principle like [SG2] using only the weakest linking principle stated above, namely [WMMG]? The left to right direction of [SG2] can be derived if we assume both [C1] and [LG1]. This might not be completely obvious, so here is the derivation in a bit of detail.

First, assume [WMMG], [M3], [LG1] and [C1]:

[1] If $x // y$ then there is some z such that z / y and $x < z$ [WMMG]

[2] x is a proper part of y iff x 's exact location is a proper part of y 's exact location [M3]

[3] If x/y then x 's exact location = y 's exact location [LG1]

[4] If $x < y$ then $x // y$ [C1]

Given [1] and [2] it follows that:

[5] If $x // y$ then there is some z such that x 's exact location is a proper part of z 's exact location and z / y .

[5] follows from [1] and [2] because [1] invokes the fact that $x < z$ and [2] tells us that $x < z$ iff x 's exact location is part of z 's exact location, so we can just substitute the locative relationship implied by [2] back into [1] to produce [5].

Given [5] and [3] it follows that:

[6] If $x // y$ then there is some z such that x 's exact location is a proper part of y 's exact location and z / y .

The difference between [5] and [6] is subtle. Whereas the right-hand side of [5] says that x is part of z , the right-hand side of [6] says that x is part of y . It is [3] that allows for the substitution of variables. [3] tells us that if z is a full ground of y then z 's exact location just is y 's exact location. Given that, in [5], z is a full ground y , then z 's exact location is equivalent to y 's. Given this, if x 's exact location is a proper part of z 's exact location, then it follows that it is a proper part of y 's exact location as well. In short, the identity in [3] allows us to swap variables between [5] and [6].

Given [6] and [4] it follows that:

[7] If $x // y$ then there is some z such that x 's exact location is a partial ground of y 's exact location and z / y .

[7] follows from [6] and [4] because [4] tells us that proper parthood implies partial grounding. Since, in [6], x 's exact location is a proper part of y 's exact location, it thus follows that it is a partial ground of y 's location.

[7], however, implies [8], below, since [8] is strictly weaker than [7]:

[8] If $x // y$ then x 's exact location is a partial ground of y 's exact location. [8] is the left to right direction of [SG2].

Can the right to left direction of [SG2] be derived in a similar way? As far as we can tell, the answer is 'no'. The difficulty lies with [LG1] and [C1]. In order to derive the right to left direction of [SG2], [LG1] needs to be strengthened to the following principle:

[LG1*]Strong Exact Co-location: x/y iff x 's exact location = y 's exact location.

And [C1] would need to be strengthened to: $x // y$ iff $x < y$, which just is a stronger version of [WMMG], namely [MMM G].

Still, even if only the left to right direction of [SG2] can be derived from mereological harmony plus [WMMG] that is notable. The left to right direction of [SG2] is an interesting principle in its own right, since it imposes a non-trivial necessary connection between the grounding structure of objects and the grounding structure of locations. Since this connection requires only [WMMG], there is scope to get structural grounding harmony from only a weak connection between mereology and grounding.¹²

¹² The fact that only the left to right version of [SG2] can be derived is one limitation on the deductive relationship between mereological and grounding harmony. Another limitation is that it is generally not possible to derive principles of grounding harmony—be they locative or structural—that involve full grounding from harmony principles that feature only proper parthood. Such derivations would require a connection between parthood and grounding along the lines of [C1], which is not generally plausible, given the formal difference in grounding relations and proper parthood relations. If, however, grounding were to be extended as a partial order, as suggested by Fine (2012) who calls this notion 'weak grounding' then it would be possible to connect parthood and full grounding, and a larger number of locative and structural harmony principles could be derived.

4 Priority monism

So far, we have introduced two kinds of grounding harmony: locative and structural. We have also considered the connection between grounding harmony of both kinds and mereological harmony. We have shown that it is possible to generate grounding harmony principles from mereological harmony principles given certain assumptions. Since there are already a number of philosophers who accept mereological harmony principles, there is some pressure on them to also accept a form of grounding harmony. The pressure is relatively modest, however, given that a connection between grounding and mereology must generally be presumed, and such a connection may be rejected.

In this section, we identify a conflict between structural grounding harmony and certain metaphysical accounts of reality. At the most general level, the problem is this: when structural grounding harmony is combined with any view in which the direction of grounding between regions does not mirror the direction of grounding for objects located at those regions, the irreflexivity of the grounding relation is undermined. There are various ways in which this mirroring can fail. One way, and the way we will focus on, arises when the direction of grounding for regions is uniform (always moving from part to whole) whereas the direction of grounding for objects located at those regions is non-uniform (sometimes moving from part to whole, sometimes moving from whole to part).

In order to demonstrate the problem, we will focus on priority monism as developed by Schaffer. We show that Schaffer's priority monism, when combined with certain reasonable assumptions, is inconsistent with at least one structural principle of grounding harmony, namely [SG2]. It is thus possible to make a case against a certain package of views that includes priority monism via structural grounding harmony. Since [SG2] is also a principle of structural grounding harmony recommended by supersubstantivalism, what we say reveals an interaction between metaphysical pictures built around priority, substantivalism, and structural grounding harmony. The use of Schaffer's priority monism is just a foil, however. Once it is seen how the problem might arise for priority monism, it is straightforward to generalise it to other views, such as certain forms of priority pluralism as well (a point we return to later).

First, a brief review of Schaffer's (2010a) priority monism is in order. According to Schaffer's priority monism, there is exactly one fundamental concrete object, and that object is the entire universe—the cosmos. All other concrete objects are parts of the cosmos and depend on the cosmos for their existence.

Schaffer's picture thus involves the idea that parts depend for their existence on wholes. However, and this is important, Schaffer only accepts this view for *organic* entities. In the case of inorganic entities, the whole depends for its existence on the parts. Inorganic entities are mere aggregates. Examples of inorganic entities include heaps and related entities (such as piles, stacks, and cognate notions). They also include gerrymandered objects of the kind that are implied by mereological universalism (the view that for any two objects, there is a third object that is composed of just those two objects).

Schaffer provides the sharpest account of the distinction between organic and inorganic entities in (2010b: 347) (note that we have altered these slightly to fit with our notation):

(Organic Unity) x is an organic unity =_{df} $(\exists y)y < x \& (\forall y)(y < x \rightarrow x/y)$

(Mere Heap) x is a mere heap =_{df} $(\exists y)y < x \& (\forall y)(y < x \rightarrow y//x)$

According to these definitions, in the case of an organic unity, the parts are grounded in the whole. In the case of a mere heap, by contrast, the whole is grounded in the parts.

It is the distinction between organic unities and mere heaps that can be used to derive a problem for Schaffer's view.

4.1 Assumptions

To derive the problem, we need a couple of further assumptions. First, we need an assumption of mereological harmony. Since Schaffer (2009: 56) takes principles of mereological harmony of the kind described above to express necessary truths, we can take a commitment to mereological harmony in the context of his monism as read.

Second, we need there to exist at least one mere heap in Schaffer's monistic system. The existence of mere heaps follows from classical mereology, which at times Schaffer takes to be a foundation for his monism (2009: 34). But he is also generally careful to say that he doesn't need to accept it, and that he can get by without the existence of arbitrary fusions. However, he also takes a heap of sand to be a mere aggregate (2009: 47), and so arbitrary fusions are not necessary to make the point.¹³

Third, we need the following assumption:

Cosmic Regions Unpack [CRU]: For any pair of spatiotemporal regions R1 and R2 that are proper parts of the region R0 occupied by the cosmos, if R2 is a proper part of R1 then R1 grounds R2.

[CRU] is not something that Schaffer explicitly endorses, but it does appear to be a corollary of his other commitments.

To see this, suppose that [CRU] is false. Then there is a pair of regions, R1 and R2, such that R2 is part of R1 and yet R1 does not ground R2. In this situation, R1

¹³ He just has to accept that there are heaps of sand, piles of clothes, stacks of bricks, piles of dirt and so on. Maybe he thinks there are no heaps of sand, and that this is implied by monism. But that in itself would be an interesting result, since you could effectively make a case against monism by making a good case for the existence of heaps of sand. Also notable is that Schaffer's meta-ontology seems to imply that there are heaps. This is because it is quite liberal: "I take entities like tables to be full-blown 'heavyweight' entries on the roster of entities, and merely add that their existence is *obvious*." (2009: 360) This may strike the reader initially as a little ad hominem, but we think it would be interesting nonetheless if it turned out that the union of Schaffer's Monism were inconsistent with his liberal meta-ontology.

fails to be an organic unity (based on the above definition). Thus, some spacetime regions are mere aggregates.

Elsewhere, Schaffer (2013) maintains that all and only organic unities evolve according to the fundamental laws.

...if some things co-evolve by the fundamental laws, it seems to me that one ought to conclude, not that each of these things is an individual substance, but rather that their system is a composite substance, for that is what forms a natural unit with respect to the dynamics. (2013: 73)

Now, if R1 is not an organic unity, then there is at least one region of spacetime that does not evolve according to the fundamental laws. But the fundamental law in this case is given by general relativity: our best theory of spacetime, which includes a description of the metric tensor field (which gives us spacetime locations). If the fundamental laws of spacetime are given by general relativity, then all regions of spacetime (including regions put together by arbitrarily summing points) evolve according to the fundamental laws. Relativity does not privilege some regions of spacetime over others in this respect, they are all born equal. So, given this picture of what an organic unity is, Schaffer should accept [CRU].

The above three assumptions: mereological harmony, the existence of heaps, and [CRU], conspire with priority monism and the asymmetry of grounding to falsify [SG2].

4.2 Problems

[SG2], it will be recalled, is the following principle: x partially grounds y iff x 's location partially grounds y 's location. To see the conflict between [SG2] and priority monism, suppose we have four objects: A, B, C, D. C is the cosmos, A and B are concrete entities that are proper parts of the cosmos, and D is a mere aggregate of A and B (A and B could be grains of sand, and D a heap). Now, consider the following argument:

- [1] A and B are proper parts of C, which is an integrated whole [Assumption]
- [2] A and B are proper parts of D, which is a mere aggregate [Assumption]
- [3] A's location, R3, and B's location, R4, are proper parts of C's location, R1 [From 1, M3]

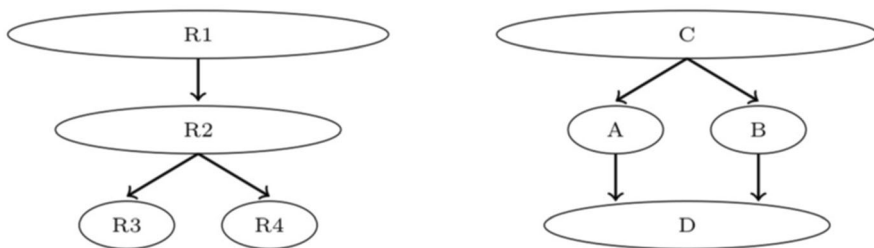


Fig. 1 The grounding structure of objects and the grounding structure of locations

- [4] R3 and R4 are proper parts of D's location, R2 [From 2, M3]
- [5] D's location is a proper part of C's location [From 3,4 and the fact that D and C are distinct]
- [6] D is grounded in A and B [From 2, definition of a mere heap]
- [7] R2 is grounded in R3 and R4 [From 6, SG2]
- [8] R2 grounds R3 and R4 [From 4, 5, CRU]
- [9] R2 grounds R3 and R4 and is grounded in R3 and R4 [From 7, 8]
- [10] It is not the case that both R2 grounds R3 and R4 and that R2 is grounded in R3 and R4 [From the asymmetry of grounding]

Premises [9] and [10] contradict, so we must reject one of the assumptions used to generate the contradiction. The basic idea behind the argument is depicted in Fig. 1. On the left-hand side, we have the grounding structure of locations; on the right-hand side we have the grounding structure of objects. A principle like [SG2] tells us to merge these two pictures. As soon as we do, however, we end up with cases of reflexive grounding.

Once the argument has been formulated, it is clear that it can be easily generalised beyond priority monism. A very similar problem can be formulated for certain versions of priority pluralism. Here's the problem in brief. According to priority pluralism, what is fundamental is many, not one. Now, suppose that a priority pluralist holds that there are just two fundamental entities, C and D, and that these are mereologically complex, organic wholes (and so the parts of C and D are grounded in those entities respectively). Suppose, furthermore that C and D are located at spacetime regions R1 and R2 respectively (which are proper parts of the region at which the cosmos as a whole is located). Finally, suppose that there is some entity $E \neq C$ located at R5 that is a mere heap, and that it is composed of parts A and B, which, in turn, are parts of C, and are located at R3 and R4 respectively. Then the above argument can be run on C (see Fig. 2).

These arguments demonstrate a general conflict between (i) believing in both organic unities and mere heaps (ii) [CRU] (iii) mereological harmony and (iv) [SG2]. Any metaphysical view that carries the right kinds of commitments (namely, commitments sufficiently close to (i)—(iv)) will therefore come into conflict with the irreflexivity of grounding in the same way. This is true for priority monism and pluralism as discussed, but even for 'middleist' positions like the one defended by Bernstein (2021). So long as one accepts that there is some grounding structure between objects, the conflict has the potential to arise.

Now, each of claims (i)—(iv) is negotiable and so there are at least four ways to address the conflict. First, one can reject the claim that both organic unities and mere heaps exist. So, for instance, priority pluralists and priority monists alike can deny that there are any mere heaps (and thus commit only to organic unities).



Fig. 2 Priority pluralism and structural grounding harmony

Second one can reject [CRU], and thus deny that grounding for spatiotemporal regions runs uniformly from whole to part. Third, one can give up on mereological harmony and deny that the mereological structure of objects mirrors the mereological structure of locations. Fourth, if one remains committed to (i)—(iii) as Schaffer seems to be, then one's only option is to give up on [SG2]. Turning this around, [SG2] can be used against a particular package of metaphysical assumptions: namely any package that includes (i)—(iii).

Suppose that one does opt for rejecting [SG2]. Are there any structural grounding principles that one can endorse? Well, notice that only a fairly modest form of structural grounding is needed. For the argument to work, we only need it to be the case that the grounding structure of objects implies a *similar* grounding structure to locations. Which is to say that the left to right direction of [SG2] derived above, based on mereological harmony and [WMMG] appears sufficient to generate the problem. Still, we think there is a way to accept structural grounding harmony even if one endorses principles like (i)—(iii), so long as one is prepared to modify structural grounding harmony in a certain respect. Once again, to show this we will focus on Schaffer's priority monism but, once again, the point easily generalises to other metaphysical views as well.

4.3 Solutions and consequences

Schaffer's particular brand of monism can be rendered compatible with structural grounding harmony. Doing so requires giving up the idea that there is a general principle, like [SG2], that applies to all objects, regardless of type. What Schaffer needs are principles of structural grounding harmony that differentiate between organic and inorganic entities. In the case of organic entities, the grounding structure of objects can perfectly mirror the grounding structure of locations. That is because, presumably, when the cosmos unpacks into concrete objects, it similarly unpacks into regions at which those concrete objects are located. Location and object, for organic entities, are in lock-step.

In the case of inorganic entities, however, the relationship between the grounding structure of objects and of locations cannot be a strict mirroring. Rather, for inorganic entities, the grounding structure of objects must be reversed against the grounding structure of locations. We can capture this idea by developing the definitions of organic and inorganic entities as follows:

[Harmonious Organics] x is an organic entity =_{df} (i) x has proper parts; (ii) all of x 's proper parts are grounded in x and (iii) the locations of x 's proper parts are grounded in x 's location.

[Disharmonious Heaps] x is a mere heap =_{df} (i) x has proper parts; (ii) x is grounded in its proper parts and (iii) the locations of x 's proper parts are grounded in x 's location.

On this picture, the contrast between organic and inorganic entities is thus mirrored by a contrast in the kind of structural grounding harmony that holds for each kind of entity. Organic entities obey structural grounding harmony, but mere

heaps do not: they break it. This suggests conditionalising the structural grounding harmony principles outlined in §3 on organic entities. So, for instance, [SG2] would become:

[OG2]Organic Exact Partial Structure: If x is an organic entity then $x // y$ iff x 's exact location partially grounds y 's exact location.

And *mutatis mutandis* for the other principles.

Despite principles like [OG2] being available to Schaffer, it is notable that structural grounding harmony principles like [SG2] are not (assuming a commitment to the other three principles that we used in our argument above). If a case can be made that structural grounding harmony should itself be unified, and thus applicable to every case of grounding regardless of the type of entity involved, then a prima face case can be made against Schaffer's view. We think there is an argument of this kind in the offing.

As previously discussed, supersubstantivalism implies structural grounding harmony. Supersubstantivalism, however, seems to imply [SG2]. For surely either all objects are identical with regions or none are. If they all are, and if the identity of object and location implies that the grounding structure of objects mirrors the grounding structure of locations, then structural grounding harmony should hold true for all objects, inorganic ones included. So, if [OG2] is true, then supersubstantivalism is false (assuming that [OG2] implies that only organic entities obey structural grounding harmony, and supersubstantivalism implies that even inorganic entities obey structural grounding harmony). There is, then, a potential argument *against* [OG2] and in favour of [SG2] based on supersubstantivalism.

Now, one might think that this is not particularly worrying for the Schaffer-style priority monist. For the priority monist of this ilk can just reject supersubstantivalism. It is not clear, however, that giving up on supersubstantivalism is the best idea. For suppose one accepts [OG2]. The question then arises as to why [OG2] is true: why accept that the grounding structure of any object reflects the grounding structure of locations? As discussed in §2, supersubstantivalism provides a tidy explanation of this fact. If supersubstantivalism is true, then objects are identical with their locations, and so any grounding structure of the objects should thus be reflected in the grounding structure of locations. Without supersubstantivalism, however, it is unclear how we might explain the correlation between the grounding structure of organic entities and the grounding structure of locations. We thus have good reason, in the presence of *any* structural grounding harmony, to accept supersubstantivalism. Once we do that, however, it is hard to see how we can retain [OG2].

In short, Schaffer-style priority monism coupled to [OG2] leaves us with the kind of unexplained correlation that Schaffer (2009) takes to motivate supersubstantivalism in the first place. So, either one has to give up on this style of motivation for supersubstantivalism, or one must give up on [OG2]. Of course, the problem is not fatal for monism in general. For, as noted above, a monist has the option of rejecting the existence of inorganic entities outright. If she does that then the conflict with

supersubstantialism would vanish (since, in this situation, [OG2] collapses back into [SG2]).

As before, it is not hard to see how the point generalises beyond Schaffer's particular take on priority monism. For any package of views that includes a distinction between organic and inorganic entities, and that also includes mereological harmony and CRU, structural grounding harmony can be recovered by shifting away from principles like [SG2] to more bespoke structural grounding principles, like [OG1] and [OG2]. The question then becomes a matter of cost: is the cost of disunity bought by cleaving [SG2] into [OG1] and [OG2] worth the gains bought back by including structural grounding harmony? Or is the cost too high (perhaps because supersubstantialism is operating in the background)?

For now, we leave these questions hanging as evidence for the potential for structural grounding harmony to play a substantive role in metaphysics. In the last section we turn to consider whether there is reason to be sceptical of structural grounding harmony.

5 The case against harmony

This brings us to the case *against* structural grounding harmony. Focus, first, on the idea that structural grounding harmony applies to grounding in full generality. One difficulty with this idea is that there are many cases of grounding that don't even seem to obey locative grounding harmony, let alone structural grounding harmony. The grounding of abstract objects is a case in point. The grounding of the singleton in its urelement is cited as a classic case of grounding. For pure sets, however, neither singleton nor urelement have locations. So, there is little sense to be made of grounds and grounded sharing locations, or of the grounding structure of those locations reflecting the grounding structure of set and urelement.

This kind of worry can be dealt with to a certain extent by moving to the conditional forms of grounding harmony principles flagged in Section Three. Thus, one can still hold that the grounding structure of *located* objects should mirror the grounding structure of locations. It might be thought, however, that even if this is true, such grounding harmony is at best a surface feature of some kinds of grounding. It is not a deep feature of grounding, and so not one that we have much reason to pay attention to. We have some sympathy for the idea that the important features of grounding should be the general features. We hasten to add, however, that everything we have said in §4 goes through with only a conditional form of structural grounding harmony. So even a restricted form of structural grounding harmony is worth considering.

A second consideration against structural grounding harmony focuses on the right to left direction of structural grounding harmony principles. Consider, again, [SG1]:

[SG1] Exact Full Structure: x / y iff x 's exact location grounds y 's exact location.

Most of our discussion has revolved around the left to right direction of this mirroring principle. This direction tells us that the grounding relationship between locations reflects the grounding structure of objects. The right to left direction, however, tells us that the grounding structure of objects must reflect the grounding structure of wherever those objects are located. To see why this might be objectionable, suppose that proper parthood implies partial grounding, and that sub-regionhood implies proper parthood. Then for any two objects, x and y , if x is located at $R1$ and y is located at $R2$ and $R1$ is a sub-region of $R2$, then *it follows that x is a partial ground of y* . So, for instance, suppose that Nox is in his cat house. Then one might be inclined to think that Nox's exact location is a proper sub-region of the location of the cat house. But then it follows from the right to left direction of [SG1] that Nox is a partial ground of his cat house (assuming, as above, that mereological relations imply grounding relations).

In response, one might argue that Nox's location is not, in fact, a proper sub-region of the cat house. The location of the cat house does not include the *interior* of the cat house, but only the region where the cat house's material parts are located (wherever the fluff is, so to speak). Then Nox's location is *disjoint* from the cat house's location, since he is where the cat house is not, despite being inside the cat house. Then Nox fails to be a partial ground of the cat house, as seems right.

More generally, we might here detect an interaction between the right to left direction of structural grounding harmony principles and concerns of material interpenetration. The thought being that if two objects genuinely share an exact location, then this can only be because the two objects are not materially distinct, in which case some grounding relation between them seems appropriate. Indeed, if one is of an optimistic bent, then perhaps there is a case for structural grounding to be found in the right to left direction of structural grounding principles. At the very least, there are ways of thinking about location where the right to left direction is not a problem.

The third consideration against structural grounding harmony focuses on one of the arguments in favour of it: namely, the arguments from mereological harmony. Someone might just reject the idea that all grounding is mereologically mediated. Indeed, a cursory glance at the many examples of grounding that have been offered does suggest some potential counterexamples to principles like [SMMG], [MMMG] and [WMMG]. Consider the following classic case of grounding: the determinate and its determinable. Thus, suppose we have a patch of crimson. Crimsonness is a determinate of redness. Some are thus inclined to suppose that the patch is red because it is crimson: determinates ground their determinables. Be that as it may, there does not seem to be a mereological relation that accompanies this case of grounding. Of course, if one is, like Paul, committed to the view that grounding relations are mereologically mediated, then the obvious thing to do is push determinate/determinable relations out of the grounding family. Such relations just are not grounding relations.

One point in favour of the view that grounding is mereologically mediated focuses on the apparent ubiquity of mereological relations. In just about every case we know of where a physical object is connected to some more fundamental object, a mereological connection also seems to be in play. Cities are composed of people,

which are composed of cells, which are composed of molecules, which are composed of atoms, which are composed of sub-atomic particles, which are composed of strings. The great chain of being, for physical objects at least, does seem to be a mereological one. The idea that grounding for physical objects is always mereologically mediated does tend to paint a very elegant picture of reality. It is, of course, compatible with this that grounding for other kinds of objects is not mereologically mediated, and thus that structural grounding harmony is only relevant for physical objects. Be that as it may, the physical is obviously quite an important domain, and so even if structural grounding harmony were to apply only to physical objects, that would make it an important notion.

Finally, one might reject structural grounding harmony on the grounds that locations don't stand in grounding relations to one another: the thought being that locations are metaphysically *flat* whereas the objects they house are *structured*. There is thus a fundamental mismatch between the metaphysics of locations and the metaphysics of objects that undermines anything like structural grounding harmony. Such a picture requires denying supersubstantialism, but then, one might think, so much the worse for that view. It also requires denying that parthood always implies grounding or that sub-regionhood implies parthood. But again, perhaps these connections can be denied anyway.

We don't have much to say to this line of thought beyond what we have already said. Structural grounding harmony clearly requires there to be some grounding structure to locations. All we can say is that a picture where locations are flat and objects are structured is a bit odd. It is strange for metaphysical structure to be 'localised' in this way, to just one kind of object. But so far as we can see there is nothing incoherent about the suggestion.

6 Conclusion

Thus, ends our exploration of grounding harmony. Here's a summary of the main points:

- (i) There are two kinds of grounding harmony: locative and structural.
- (ii) Mereological harmony implies both kinds of grounding harmony, given certain assumptions.
- (iii) Certain packages of metaphysical views, such as Schaffer-style priority monism, are incompatible with some structural grounding harmony principles.
- (iv) Structural grounding harmony is implied by supersubstantialism and by the view that grounding is mereologically mediated
- (v) Structural grounding harmony may not be a fully general principle, for all cases of ground, but even if it's not it can still do substantive work in the metaphysics of physical objects.

Many outstanding questions remain: what is the connection between locative and structural grounding harmony (e.g., does one require the other)? What are the

reasons for or against locative grounding harmony? (we touched on some of the motivations for specific principles, but there is clearly more to say). Are there other substantive metaphysical positions that are ruled out by a commitment to structural grounding harmony? Are there arguments for either kind of grounding harmony beyond the considerations adduced here? We don't have the answers, but we hope to at least have shown that such questions are worthy of further consideration.

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