

# On the Plurality of Grounds

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RECENT METAPHYSICS HAS CONTAINED A GOOD DEAL OF DISCUSSION about the notion of *ground*. The notion is intuitive enough. For instance, suppose there is a conference occurring. One might say that this is grounded in how its participants are acting, meaning (roughly) that the conference “consists in” or is “explained by” or is “nothing over and above” those actions, or that there is a conference “in virtue of” those actions. The idea is that once you have participants acting in a certain way, this “makes it the case” that there is a conference. Regardless of whether this claim about the conference’s ground is true, we understand it reasonably well.

One reason why the notion of ground has sparked such interest is the idea that it is needed to formulate many core philosophical issues. Consider for example theses like materialism about consciousness, normative naturalism, and phenomenalism. These claim that certain facts—about conscious states, norms, and external objects (respectively)—“arise out of” or are “determined by” or “fixed by” various underlying facts—about my brain, or natural properties, or sense data (respectively). But how should this talk of “determination” or “fixing” be understood? One might suggest that it be understood in terms of supervenience, or analysis, or identity. But a number of philosophers have argued that it is best understood in terms of ground.<sup>1</sup> On their view, the above theses state (respectively) that the material state of my brain grounds my conscious states, that the natural facts ground the normative, and that patterns of sense data ground the existence of external objects. If they are right, the notion of ground itself becomes an obvious topic of interest in its own right.

In this spirit, one aim of this paper is to argue that ground is *irreducibly plural*. It is well known that something’s ground can be a plurality—the occurrence of a conference is an example of something that is presumably grounded in a multitude of facts concerning the actions of its many participants. *Those* facts together *are* what explains why there is a conference occurring, even though none of them is a sufficient explanation individually. But the literature uniformly

1. See for example Fine (2001), Rosen (2010), and Schaffer (2009). I will not rehearse their arguments here.

assumes that what is grounded must be a single fact. Here I disagree and argue that what is grounded can be a plurality too: there can be cases in which *they*, the members of a plurality, *are* explained in more fundamental terms, even though none of them admits of explanation on its own.

If ground is irreducibly plural, this is important to know. For (as I said) fans of ground are tempted to see much contemporary philosophy as attempting to establish whether facts of one type (say, the natural) are sufficient to ground facts of another (say, the normative). And an obvious strategy of arguing in the negative is to argue that a given fact of the latter type cannot be grounded in facts of the former type. But if ground is irreducibly plural then this form of argument is invalid. For even if one were to successfully argue that there is no natural ground of the fact that I ought not eat meat, it would remain open that the normative facts taken together have a natural ground in which case normative naturalism would be vindicated after all. As we will see, this invalid form of argument may be responsible for certain popular views in metaphysics, in which case it is important that the mistake be exposed.

My claim that ground is irreducibly plural is a claim about the logical form of ground. It is the claim (to be clarified below) that, logically speaking, ground is a binary relation plural in both positions: *they* are grounded in *them*. Of course the limit case is a plurality of one, so it may turn out (as it happens) that in each actual case of ground a single fact is grounded on its own. Still, on my view the claim in each case would strictly speaking remain plural: that *they* (all one of them!) are grounded in *them*.

However, I believe that there are actual examples in which many facts are grounded together. Consider the individualistic facts, facts that concern particular individuals, such as:

*Socrates was wise.*

*Obama is president.*

*This very book (pointing at the book on my table) is interesting.*

I believe that these facts together are (plurally) grounded in purely qualitative facts, even though none of them has a qualitative ground when taken on its own. Or consider facts about the mass-in-kilograms, such as:

*Obama is 75 kgs.*

*My laptop is 2 kgs.*

*The book is 1/2 kg.*

I believe that these facts are (plurally) grounded in the mass relationships between things, even though none of them has such a ground when taken alone. Indeed the same goes (I claim) for distance-in-meters, time-in-seconds, preferences-in-utils, and other cases in which there are mathematical values of a given quantity in a given scale. In each case my view is that facts about the mathematical values in a given scale are *plurally* grounded in the underlying, scale-independent facts (about geometry, time, or preferences respectively).

But I will focus on the case of individuals and mass-in-kilograms in what follows. The result is a *structuralist* view of individuals and kilograms respectively, since an account of any one member of the group is inevitably an account of them all.<sup>2</sup>

Now, each structuralist view implies a strong claim that there is no room to motivate or defend here, namely that the world is fundamentally qualitative (in the first case) and that mass is fundamentally relational (in the second). So I cannot very well argue that ground is plural just by pointing at these examples! And I do not know of uncontroversial examples to appeal to instead.

So the argument will have to be indirect. I will start by arguing for the conditional claim that *if* the world is fundamentally qualitative,

2. 'Structuralism' is a term that is already applied too widely, so I apologize for the further abuse. I will discuss the relation between my views and other views that go by the name as we go along.

then the individualistic facts are plurally grounded in the qualitative (sections 2–5). Then I will argue (on the basis of the very same kinds of considerations) that *if* mass is fundamentally relational *then* the kilogram facts are plurally grounded in those mass relationships (sections 6–8). Sections 9–10 then develop each structuralist view and respond to objections. This will not establish that either structuralist thesis is true (since I will have only motivated the conditional claims), but it will suggest that these structuralist hypotheses are coherent and intelligible and worth taking seriously. And so our view about the logical structure of ground should allow for these hypotheses: we should think that ground is irreducibly plural.

Though I only argue for the conditional claims here, I have argued for the antecedent of each conditional in other work.<sup>3</sup> So this paper completes the argument for structuralism in each case. The paper therefore has three distinct topics – the nature of ground, the nature of individuals, and the nature of quantities like mass – but each topic will inform the others.

### 1 More on Ground

It is important to clarify the notion of ground at issue. As I use the term, ‘ground’ is an *explanatory* notion: to say that X grounds Y just is to say that X explains Y, in a particular sense of ‘explains’. The earlier example illustrates the particular sense. Imagine you are at a conference, and imagine asking why a conference is occurring. A causal explanation might describe events during the preceding year that led up to the conference: someone thought that a meeting of minds would be valuable, sent invitations, etc. But a different explanation would say what goings-on make the event count as a conference in the first place. Someone in search of this second explanation recognizes that conferences are not *sui generis*, so that there must be some underlying facts about event *in virtue of which* it counts as being a conference,

3. I argue that the world is fundamentally qualitative in Dasgupta (2009) and (forthcoming), and that mass and other quantities are fundamentally relational in Dasgupta (2013).

rather than (say) a football match. Presumably it has something to do with how the participants are acting, for example that some are giving papers, others are commenting, and so on. An answer of this second kind is a statement of what *grounds* the fact that a conference is occurring.

We should distinguish between full and partial explanations. A single conversation might partly explain why a conference is occurring, but does not fully explain it. By ‘ground’ I mean a full explanation.<sup>4</sup>

What is the logical form of a claim about grounds? Explanations are typically expressed with the sentential operator ‘because’: it was a conference *because* its participants were acting in certain ways. So one standard view is that the logical form of a claim about ground is:

S because  $\Gamma$

where S is a sentence,  $\Gamma$  is a list of sentences, and ‘because’ is read in the metaphysical rather than causal sense.<sup>5</sup> Informally, the sentences in  $\Gamma$  describe those aspects of the world that together explain its being the case that S. It is important that  $\Gamma$  is a list and not a conjunction: we would like to make sense of the plausible view that conjunctions are grounded in their conjuncts, but if  $\Gamma$  were a conjunction this would collapse into the view that a conjunction is grounded in itself.

Now, this logical form presupposes what I call a *singularist* view of ground, according to which any aspect of the world that admits of explanation can be explained on its own. I will be arguing that singularism is wrong and that sometimes a plurality of aspects taken together can be explained even though none of them can be explained when taken alone. But this *pluralist* view of ground is unintelligible given the above logical form, so the pluralist will instead take the logical form to be:

$\Delta$  because  $\Gamma$

4. To be clear, a fact may have more than one full ground. If P and Q both obtain, then  $P \vee Q$  is (fully) grounded in P, and also in Q.
5. This logical form is suggested by Fine in his (2001) and (2012).

where both  $\Gamma$  and  $\Delta$  are lists of sentences.<sup>6</sup> Informally, the aspects of the world described by the sentences in  $\Delta$  are explained, when taken together, by the aspects described by the sentences in  $\Gamma$ , even though there is no presumption that each sentence in  $\Delta$  describes something that can be explained on its own. According to the pluralist, the singularist mischaracterized the logical form by generalizing from special cases in which the number of sentences in  $\Delta$  is one.

My official approach is to treat ground as a sentential connective, but it streamlines prose to treat it as a relational predicate that applies to facts. Since my talk of facts is just a convenient shorthand, there is no need to say much about what facts are; however, I will assume that they are reasonably fine-grained and that logically equivalent facts can be distinct.<sup>7</sup> On this way of talking, a singularist will take the logical form of a grounding claim to be:

Y is grounded in the Xs

where 'Y' is a singular variable and 'the Xs' is a plural variable, both ranging over facts.<sup>8</sup> But the pluralist will instead let Y be a plural variable and replace 'is' with 'are': she says, of the many Ys, that *they are* grounded in the Xs, with no presumption that each Y has a ground on its own.

I make two assumptions about ground. The first is that the grounded is metaphysically necessitated by its grounds. More formally:

If  $\Delta$  because  $\Gamma$ , then it is metaphysically necessary that if  $\wedge\Gamma$  then  $\wedge\Delta$

where  $\wedge X$  is the conjunction of the sentences in the list X. This principle (or, more precisely, the singularist restriction of it) is endorsed in much

6. Both the singularist and the pluralist will likely allow the lists to be infinite.
7. Correia (2011) discusses how fine-grained the notion of fact must be in the context of questions of ground.
8. This logical form of ground is endorsed by Rosen (2010).

of the recent literature on ground.<sup>9</sup> And it has some plausibility: if the event was a conference because of how the participants were acting, then those actions are *what made it the case* that it was a conference, and are that *in virtue of which* it was at conference. But then (the idea is) those actions must be sufficient for the event to have been a conference. To be sure, the principle is controversial and some have argued that it is false.<sup>10</sup> But here I will assume the principle without further discussion.

However I do not assume the reverse scheme, since there can be necessary connections without grounds: it is metaphysically necessary that if Obama exists then  $2+2=4$ , but Obama's existence does not explain why  $2+2=4$ . Nor do I assume that the grounded necessitates its ground, since a disjunction may be grounded in one of its disjuncts without necessitating it.

My second assumption is that all parts of an explanation must be explanatorily relevant: if the Xs ground the Ys and  $x$  is one of the Xs, then  $x$  is *explanatorily relevant* to the Ys in the sense that  $x$  plays at least some role in making it the case that the Ys obtain.<sup>11</sup> This assumption is natural in the case of causal explanation: even if the conference is causally explained by someone's desire to orchestrate a meeting of minds, it is not causally explained by that desire *and the number of electrons in Alpha Centauri*, for the latter is irrelevant to the matter in the sense that it played no role in bringing about the conference. I assume the same for ground: even if the event's being a conference is grounded in various facts about how its participants acted, it is not grounded in those actions *and the number of electrons in Alpha Centauri*, for the

9. See for example Fine (2012) and Rosen (2010). For an extended argument in its favor see Trogdon (2013).
10. See for example Leuenberger (2013) and Schaffer (2010).
11. When I say that  $x$  must be relevant to the Ys, I mean this in the non-distributive sense: I do not assume that  $x$  must be relevant to each of the Ys individually or even to just one of the Ys. For the root idea is that explanans must be relevant to the explanandum — so the natural extension of that root idea if ground is irreducibly plural is that explanans must be relevant to the (perhaps many) explananda in this non-distributive sense.

latter played no role in making the event count as a conference and so is irrelevant to the matter. This requirement of relevance is widely endorsed; indeed it is one of the central features used to distinguish ground from metaphysical necessitation and logical consequence.<sup>12</sup>

It is important that we do not *define* a fact  $x$  to be explanatorily relevant to the  $Y$ s iff  $x$  is one of some  $X$ s that ground the  $Y$ s, for then my assumption would become a tautology and lose its teeth. This is not the place to discuss whether the notion of relevance can be defined otherwise: here I take it to be another primitive alongside ground.<sup>13</sup> My assumption is therefore a substantive principle linking two distinct notions. The assumption is not beyond doubt, but I will not defend it here.

It is sometimes assumed that ground is transitive.<sup>14</sup> What does this mean? We know what it is for a binary *singular* relation to be transitive, but what about a binary *plural* relation? One can formulate a number of transitivity-like principles, but I will not assume any of them here. Still, it will be useful to speak of the transitive closure of ground on one sense of the term. To this end, let us stipulate that ground is *transitive* iff:

- (i) If the  $X$ s ground the  $Y$ s, and the  $Y$ s along with the  $Y^*$ s ground the  $Z$ s, then the  $X$ s along with the  $Y^*$ s ground the  $Z$ s, and
- (ii) If the  $X$ s ground the  $Y$ s along with the  $Y^*$ s, and the  $Y$ s ground the  $Z$ s, then the  $X$ s ground the  $Y^*$ s along with the  $Z$ s.<sup>15</sup>

12. This assumption is explicit in Fine (2012) and Rosen (2010), and is central to their respective conceptions of ground. To be clear, if  $X$  is explanatorily relevant to  $Y$ , this does not imply that every explanation of  $Y$  appeals to  $X$ . For example, if  $P$  and  $Q$  both obtain then  $P \vee Q$  is fully grounded in  $P$ , and also fully grounded in  $Q$ . So not every explanation of  $P \vee Q$  appeals to  $P$ , but  $P$  is explanatorily relevant to  $P \vee Q$ .

13. Fine (2012) argues that ground and relevance cannot be defined in terms of each other.

14. Though not always. Rosen (2010) remains agnostic, and Schaffer (2012) and Tahko (2013) have both argued against transitivity. Litland (2013) offers a response to Schaffer's arguments.

15. Thanks to Daniel Berntson for help in formulating this principle.

Then call the transitive closure of ground (in this sense of 'transitive') the notion of *derivative ground*.

## 2 Individualism and Qualitativism

I now turn to my first conditional claim: that *if* the world is fundamentally qualitative *then* the individualistic facts are plurally grounded in the qualitative facts (sections 2–5). What is meant by 'individualistic' and 'qualitative'? I will not try to define these terms, but roughly speaking a fact is individualistic iff whether it obtains depends on how things stand with a particular individual (or individuals) and qualitative otherwise.<sup>16</sup> By 'individuals' I mean what in ordinary English we call 'things'—apples, alligators, atoms, and so on. We express individualistic facts with directly referring expressions, *e.g.*

*That (pointing at a particular apple) is juicy.*

*Obama is the president.*

These are individualistic because whether they obtain depends on how things stand with that apple and Obama, respectively. And in first-order logic, we regiment our talk of individualist facts with constants, *e.g.*

$a$  is  $F$

$a$  bears  $R$  to  $b$

$a=b$

where  $a$  and  $b$  are individuals. In contrast, examples of qualitative facts include

*Someone is the president.*

16. More precisely: a fact  $F$  is individualistic iff there are some  $X$ s such that whether  $F$  obtains depends on how things stand with the  $X$ s. But I will continue to use the more readable expression in the text. A complete definition would need to refine the notion of dependence, among other things, but the idea is clear enough for our purposes.

*Orange is more similar to red than to blue.*

*Redness and roundness are co-instantiated.*

since whether each of these obtain does not depend on how things stand with any particular individual. Perhaps the first depends on there being *some individual or other* who is the president, but it is qualitative because it does not depend on any particular person being the president. We can express some qualitative facts in first-order logic, e.g.

$$(\exists x)Fx$$

$$(\exists x)(\exists y)(Fx \ \& \ Gy \ \& \ \sim x=y)$$

$$(\forall x)(Fx \supset Gx)$$

so long as the predicates F and G express qualitative properties.<sup>17</sup> But it may be that not all qualitative facts can be so expressed.

One might of course try to define the distinction between individualistic and qualitative facts in more detail, but the intuitive idea glossed here is sufficient for our purposes.

Now, of the qualitative and the individualistic, which are the more fundamental? A natural view is that the most fundamental facts are individualistic facts about how a domain of individuals are propertied and related to one another, and that they are sufficient to ground (or at least derivatively ground) the qualitative facts. Let us call this *individualism*. In contrast, let *qualitativism* be the opposite view that the most fundamental facts are qualitative facts and that they are

17. And what is a qualitative property? Roughly, one that does not concern any particular individual. For example, being seated, having a sister, and having two sisters are all qualitative: even if one's having these properties implies the existence of other individuals, they do not concern any particular individual. These contrast with non-qualitative properties such as being Kripke and being Obama's sister, which concern the individuals Kripke and Obama respectively. Obviously this raises the question of what it is for a property to "concern" a given individual, but I will not answer this here (I am not trying to give a reductive definition).

sufficient to ground (or at least derivatively ground) the individualistic facts. Qualitativists may disagree on what kind of qualitative facts one finds at the bottom level: the traditional bundle theorist says that they concern which monadic, qualitative properties are compresent; other qualitativists think that they are the facts that can be expressed in predicate logic with identity (but no constants); and other qualitativist views are possible too.<sup>18</sup>

Individualism is perhaps the more natural position. Suppose that an individual *x* is both red and round. It follows that something is red and round. But it is natural to think that something is red and round *because x* is red and round, just as the individualist says. However, I favor qualitativism. Very briefly, my reason is that if individualism were true then the individualistic facts of our world would lie beyond our epistemic ken. The idea is that our knowledge of the world is limited to knowledge of its qualitative nature and whatever is grounded in that qualitative nature, and since individualism implies that there are further facts of the matter as to which particular individuals lie behind those qualities it follows that those facts would be unknowable. A reasonable Occamist principle then recommends that we dispense with such epistemically inaccessible facts.<sup>19</sup>

18. I motivate a different qualitativist view in Dasgupta (2009) and (forthcoming), which uses the resources of algebraic logic to describe how qualitative properties are "stitched together" to construct qualitative facts. L.A. Paul (2002) and (2012) develops yet another version, based on the idea that qualitative properties are parts of individuals. Hawthorne & Sider (2002) explore a number of different qualitativist views without endorsing them. I have not mentioned views that eliminate individualistic or qualitative facts altogether. This is because the recent interest in ground is largely driven by the idea that the benefits of eliminativist views can be enjoyed by more plausible views about what grounds what.

19. Roughly this line of argument can be traced back to Leibniz. I develop it in some detail in Dasgupta (2009) and (forthcoming). Note that there is no epistemic problem for the qualitativist precisely because she thinks that individualistic facts are grounded in qualitative facts and so she denies that they are (in the relevant sense) "further facts" about the world beyond its qualitative nature.

The epistemic premise — that knowledge is limited to the qualitative and what is grounded in the qualitative — is controversial (to say the least!) and

However, my aim here is not to argue for qualitativism but instead to argue that *if* qualitativism is true *then* individualistic facts are *plurally* grounded in the qualitative, not one by one.

Before arguing for this, it is important to ward off two potential misconceptions as to what qualitativism is. The first potential misconception is that qualitativism cannot make sense of situations in which distinct individuals are qualitatively alike. An example of such a situation is the infamous “Max Black” world, a world in which there are just two spheres of iron 2 miles apart that share all their intrinsic qualitative properties (they are exactly the same size, shape, color, etc). Now, it is true that *some* qualitativist views cannot make sense of this situation. If the traditional bundle theory is the view that each sphere is *identical to* the collection of its qualitative properties, then — since (by hypothesis) both spheres have exactly the same such properties — it follows that they are identical, and so there are not two distinct spheres after all.

But as emphasized earlier, there are other qualitativist views. One is that the underlying qualitative facts are those expressed by predicate logic with identity (but no constants), in which case there is no difficulty describing such a situation with something like the following:

$$(\exists x)(\exists y)(Fx \ \& \ Fy \ \& \ x \text{ is 2 miles from } y \ \& \ \sim x=y)$$

where F expresses the complete intrinsic qualitative nature of each sphere. And the qualitativist view I develop in Dasgupta (2009) can also make sense of such situations. In any event, the potential

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deserves more discussion than I can give it here. But, just to be clear, it does not (without other assumptions) rule out *de re* or first-personal knowledge, and it does not say that we acquire such knowledge by deriving it from qualitative knowledge. It “just” says that whatever is known in those cases must ultimately have a qualitative ground.

misconception to ward off is the idea that qualitativism *per se* rules out such situations — it does not, even if some versions of it do.<sup>20</sup>

The second potential misconception to ward off is the idea that qualitativism is just anti-haecceitism (and likewise that individualism just is haecceitism). This is a mistake. For anti-haecceitism (at least as characterized in the recent literature) is a *modal* thesis, a thesis to the effect that there can be no difference in the way the world is individualistically without a qualitative difference. Admittedly, the term ‘anti-haecceitism’ has been used for a number of related modal claims, some expressed with modal operators and others with quantification over worlds.<sup>21</sup> But they are all modal claims, not grounding claims, and so none of them imply qualitativism for the reason that a necessary connection does not imply a connection of ground: as I said in section 1, if the Xs necessitate Y, this does not imply that the Xs ground Y. Of course it follows from my assumption that the grounded is necessitated by its grounds that qualitativism implies anti-haecceitism (in at least

20. Thus qualitativism *per se* does not imply the Principle of the Identity of Indiscernibles (PII), the principle that indiscernible things are identical. This principle comes in a variety of different flavors depending on which notion of ‘discernibility’ is in use. Objects *x* and *y* are *absolutely discernible* (roughly speaking) iff there is a monadic qualitative property that *x* has and *y* does not. And objects *x* and *y* are *weakly discernible* (again, roughly speaking) iff *x* and *y* stand in an irreflexive relation to one another. (These notions of discernibility were clarified and brought to bear on issues in the philosophy of physics by Saunders [2003].) The two spheres in the Max Black world are absolutely indiscernible since they share all their monadic qualitative properties, both intrinsic (*e.g.* being brown) and relational (*e.g.* being 2 miles from an iron sphere). But they are weakly discernible since they each stand in the irreflexive qualitative relation of *being 2 miles from* with something. The point in the text (then) is that qualitativism does not imply the PII stated with the notion of absolute discernibility. Nor, we can now add, does it imply the PII stated with the notion of weak discernibility. For even if every qualitative relation that the two spheres stand in is one that each sphere stands in to itself, it remains the case that such a situation could be expressed in predicate logic with identity (but no constants).

21. Lewis (1986, chapter 4) characterized anti-haecceitism as the view that any two possible worlds that agree qualitatively agree about what they represent *de re* of any given individual. Others (for example, Pooley [2005]) characterize it as the view that possible worlds that agree qualitatively are identical. Yet others (including Skow [2008]) characterize it with modal operators.

one of its characterizations). So if you are an anti-haecceitist this might be because you are a qualitativist. But it might instead be because you are an individualist who holds independent views about the workings of *de re* modality that imply anti-haecceitism.

I believe this latter position was Lewis'. He was an anti-haecceitist (in at least one of its guises), but was he a qualitativist? I suspect not. This is not altogether clear since he never wrote explicitly in terms of ground. But someone with qualitativist inclinations (regardless of whether they speak in terms of ground) would be likely to endorse the traditional bundle theory or develop some other theory of what the underlying qualitative facts are like, and Lewis never did this. Indeed he had the perfect opportunity to offer such a theory when telling us what a possible world is in Chapter 1 of *On the Plurality of Worlds*, where he could have said that a possible world is some kind of collection of qualitative universals. But instead he tells us that it is a mereological sum of *individuals*. So while Lewis is an anti-haecceitist, I see no evidence that he was a qualitativist. In my view his anti-haecceitism is best understood as following from his views about the nature of *de re* modality, not his views about nature of individuals.

So qualitativism is an explanatory (and not a mere modal) claim. And like any explanatory claim, it faces the challenge of showing that the explanantia really are sufficient to *explain* the explananda – in this case that the fundamental qualitative facts really are sufficient to explain the individualistic facts. The anti-haecceitist faces no such challenge since she only asserts a *modal* connection and not an explanatory connection. But for the qualitativist, meeting the challenge is crucial: if she cannot meet it, she would have to endorse an eliminativism about individualistic facts and claim that there are no such things! Insofar as this is an intolerable consequence, meeting the challenge is crucial for the success of qualitativism.

It is this challenge that I take up here. My thesis is that the qualitativist does indeed face significant difficulties in meeting this challenge *if* she tries to ground each individualistic fact one by one, but that these problems dissolve if she grounds them plurally.

### 3 Finding Obama in a Qualitative World

To see why, recall that the qualitativist says that individualistic facts are *derivatively grounded* in the qualitative nature of the world. This implies that there is a non-empty set  $S$  of individualistic facts that are *grounded*, and not just derivatively grounded, in the qualitative.<sup>22</sup> It will help to work with an example, so let us suppose (without loss of generality) that  $S$  contains the fact that Barack Obama exists. My opponent thinks that this fact when taken alone is grounded in some set  $Q$  of qualitative facts. But what could  $Q$  possibly be? I will argue that any candidate set  $Q$  that *necessitates* Obama's existence contains *irrelevant* facts; or, contrapositively, that if  $Q$  is restricted to facts that are *relevant* to his existence then it will *not necessitate* his existence. So my two assumptions – that a ground must both necessitate and be relevant to what it grounds – pull in opposite directions and cannot be jointly satisfied. Then I will show that these problems dissolve if we plurally ground all the facts in  $S$  together.

Let us start by trying to construct a candidate set  $Q$ . We might start with facts concerning the existence of something with just a few of Obama's qualitative properties, such as being born on a small island and being well educated. But this would clearly not be sufficient to ground Obama's existence since it is possible for someone to have those qualities and yet for Obama not to exist.

So let us try adding to  $Q$  more facts about Obama's qualitative nature. To this end, let  $R$  be a bounded region of space-time containing Obama, perhaps the region filled by the entire history of our solar system. And let  $Q_R$  be the set of facts characterizing the entire intrinsic nature of  $R$  in its most fundamental qualitative respects. Does  $Q_R$  ground Obama's existence? No, because it does not necessitate his existence. For it is possible for there to be a region of space-time  $R^*$  disjoint from  $R$  which agrees intrinsically with  $R$  in all its most fundamental qualitative respects – *i.e.* in which all the facts in  $Q_R$

22. If ground is transitive then  $S$  is the set of all individualistic facts, while if it is not then it may be a proper subset; but for our purposes all that matters is that  $S$  is not empty.



obtain—but which contains different individuals. It might help to imagine (though this is not crucial to the argument) that  $R^*$  is spatio-temporally far removed from  $R$ . Moreover it is possible for there to be such a region  $R^*$  and yet for  $R$  to differ in such a way that Obama never existed: perhaps all we need to suppose is that his parents never met. Since all the facts in  $Q_R$  would obtain in this possibility, it follows that  $Q_R$  does not necessitate Obama's existence and hence does not ground his existence either.

The possibility I describe here is not controversial. It is uncontroversial that in Moscow there could be an intrinsic duplicate of my laptop—call it  $l$ . And it is uncontroversial that  $l$  could exist unchanged even if my laptop differed in some intrinsic respect (perhaps it lost a key). I am just making an analogous modal claim about the spatio-temporal region  $R$ .

This is not to deny that there are facts about the nature of  $R$  that could explain his existence. Essentialists about origins might explain his existence by the fact that a particular sperm fertilized a particular egg within  $R$ . Others might explain his existence in terms of some particular fundamental particles in  $R$  that compose him. I have no objection to these explanations, but they are not available to the qualitativist since they both appeal to individualistic facts. What the above argument shows is that nothing about the *qualitative* nature of  $R$  could ground Obama's existence.<sup>23</sup>

What then must be added to  $Q_R$ ? It is no use adding a fact that is necessitated by  $Q_R$  itself, such as generalizations that are grounded in  $Q_R$ , for the resulting set would still not necessitate Obama's existence (if it did, then  $Q_R$  would necessitate his existence on its own). But  $Q_R$  was a complete characterization of the intrinsic nature of our entire solar system in its most fundamental qualitative respects. So to necessitate Obama's existence we must add facts about the qualitative

23. One might think that the solution is to qualitatively ground those individualistic facts about the particles or the egg and sperm. But exactly the same problems will recur. This is just to say that the current argument does not depend on my decision to discuss the fact that Obama exists and will apply to other individuals too.

nature of the cosmos outside our solar system. We might for example add facts concerning the qualitative nature of some region in Alpha Centauri. But the problem is that even if the resulting set necessitates Obama's existence, those goings-on in Alpha Centauri seem *irrelevant* when it comes to explaining his existence. Surely what happens in Alpha Centauri plays no role in making it the case that *Obama* exists. To see this, suppose you succeeded in explaining why *someone* with a certain qualitative profile exists, and I then asked, 'Yes, but in virtue of what is he *Obama*?' If you then started talking about Alpha Centauri, I would likely assume that you had misunderstood the question since your answer would be too bizarre to take seriously! Remember, the kind of explanation at issue here is metaphysical, not causal. Facts about the goings on in distant regions of spacetime might be relevant to a *causal* explanation of how heavy elements came into existence and therefore what caused Obama to exist. But we are asking for a *grounding* explanation of Obama's existence and it is almost inconceivable that the correct answer could include the goings on outside our solar system.

My premise is that these facts about the universe outside  $R$  are irrelevant to the matter.<sup>24</sup> I will support the premise in section 4 below, but it is very plausible. For recall how natural it would be to explain Obama's existence in terms of facts about the particular fundamental particles that compose him, or the fact that a particular sperm fertilized a particular egg. This explanation is not available to the qualitativist, but the fact that it is so natural shows that we take facts about goings-on outside our solar system to have nothing to do with the matter. If one resists my premise, one resists a very plausible starting point.<sup>25</sup>

24. By facts 'about' the universe outside  $R$  I include specific facts about particular regions, for example about particular electrons in Alpha Centauri. But I also include general facts such as that every region outside  $R$  has certain characteristics. The inclusion of the latter makes sense because they will (plausibly) be grounded in the former, so that if Obama's existence is grounded in the latter it will be derivatively grounded in the former. So, if the former are objectionable in an explanation of Obama's existence, then so too are the latter.

25. To be clear, one might ask two questions here. First, *if qualitativism is true*, are facts about Alpha Centauri relevant to explaining Obama's existence? And

I granted for the sake of argument that adding facts about Alpha Centauri to  $Q_R$  would result in a set that necessitates Obama's existence, but this was too concessive. Our previous argument that  $Q_R$  does not necessitate his existence made very few assumptions about R, so incrementally enlarging R does not address the underlying problem. So is there *any* set of qualitative facts that necessitates his existence? The most plausible suggestion is a complete qualitative specification of the entire cosmos, plus a "totality fact" to the effect that they are all the qualitative facts there are. Call this set  $Q_T$ . Does  $Q_T$  necessitate Obama's existence? I do not have a firm intuition either way so I am happy to concede that it does. Indeed since  $Q_T$  contains the totality fact our above argument cannot be used to show that it does not. Moreover, we are arguing that *if* qualitativism is true *then* the individualistic facts are plurally grounded in the qualitative, and it follows from qualitativism (and our assumption that the grounded is necessitated by its grounds) that the qualitative facts necessitate any given individualistic fact. So denying that  $Q_T$  necessitates Obama's existence is not dialectically available here. So  $Q_T$  appears to be the best candidate for a set of qualitative facts that necessitates Obama's existence. But of course  $Q_T$  contains facts about the qualitative goings-on in all corners of the entire cosmos, and most of those goings-on are irrelevant to an explanation of why *Obama* exists.

That is the basic idea: in attempting to find a qualitative ground that plausibly *necessitates* Obama's existence, we are forced to include facts that are *irrelevant* to the matter. Or put the other way: in zeroing in on the facts that are *relevant* to an explanation of his existence, we find that they no longer *necessitate* his existence. The above is an argument-scheme that can be filled in for different values of R: if you think (as I do) that the qualitative goings-on in Jupiter are explanatorily irrelevant to Obama's existence, you could take R to be a region that includes our planet and not much else and the argument would go through just the same.

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second, *regardless of whether qualitativism is true*, are facts about Alpha Centauri relevant? I think the answer to both questions is clearly 'No.'

The argument has nothing to do with whether Obama is "discernible" from other things in the contemporary meanings of that term. For example, it has nothing to do with whether there is a (perhaps complex, highly relational) qualitative property that only he instantiates. For even if there is such a property the question remains whether its instantiation *explains* Obama's existence, and the argument is that there are constraints on explanation (necessitation and relevance) that suggest not.<sup>26</sup>

I said that these problems dissolve if we plurally ground individualistic facts in qualitative facts. How so? One simple proposal is to let  $I_T$  be the set of all individualistic facts and let (as before)  $Q_T$  be the set of all qualitative facts, and say that the members of  $I_T$  are (plurally) grounded in the members of  $Q_T$  even though no member of  $I_T$  is grounded in any subset of  $Q_T$ . This a *structuralist* view of individuals, since it implies that an account of any one individual is inevitably an account of them all. But that is just one proposal and there are many details to argue about. Some might argue that the qualitative ground should include only certain kinds of qualitative facts such as existential generalizations or facts about how properties are bundled together. Others might insist that only a proper subset S of individualistic facts (*e.g.* facts about the fundamental particles) are plurally grounded in the qualitative and that other individualistic facts are grounded singularly in some members of S. Still others might want to say that structuralism is not just true but necessarily true. But these are in-house arguments between theorists all of whom deserve to be called structuralists. Since the differences between their views will not matter here, I will focus on the simple proposal described above.

26. There is an extensive recent literature on the question of whether various individuals are discernible from one another in the absolute or weak sense defined in footnote 20. For example see Ladyman & Ross (2007) and references therein. These questions about discernibility are interesting, but (as I said in section 2) they are not ours. I discuss the relation between qualitativism and these other views about discernibility in Dasgupta (2011).

A chief advantage of structuralism is that it avoids the difficulties we faced when trying to ground Obama's existence on its own. For one thing,  $Q_T$  contains no irrelevancies when it comes to explaining the members of  $I_T$  together. To be sure,  $Q_T$  does contain irrelevancies when explaining Obama's existence on its own, such as qualitative facts about electrons in Alpha Centauri. But since  $I_T$  contains individualistic facts about those very electrons the qualitative facts about them would appear to be perfectly relevant when explaining  $I_T$ 's members! And as we saw earlier (when discussing the idea that  $Q_T$  grounds Obama's existence) it is not implausible that  $Q_T$  necessitates all the individualistic facts  $I_T$ . (Moreover, as we also saw, if one denies that  $Q_T$  necessitates  $I_T$  then one denies qualitativism, and here I am attempting to establish that *if* qualitativism is true *then* the individualistic facts are plurally grounded in the qualitative.) The problems we faced when trying to ground Obama's existence on its own therefore dissolve when we instead ground individualistic facts plurally.

None of this implies that structuralism is the best form of qualitativism, since structuralism may suffer from problems of its own. Still, it is evidence in its favor.

Of course if structuralism is true then there is *a sense* in which the members of  $Q_T$  "give rise to" Obama's existence, even if they do not ground it. More precisely, let us say that some facts  $\Gamma$  *account for* a fact  $Y$  iff there are some facts  $\Delta$  such that  $\Delta$  are (plurally) grounded in  $\Gamma$  and  $Y$  is a logical consequence of  $\Delta$ . Then structuralism implies that  $Q_T$  accounts for Obama's existence. But 'accounts for' is not a purely explanatory notion — at least, not if (as I am assuming) relevance is required for explanation — since relevance is not preserved under logical consequence. If the question is what the members of  $Q_T$  *explain*, the structuralist says that they explain the members  $I_T$  together but not individually. Distinguishing between ground and accounting is not splitting hairs: as I said in section 1, the requirement of relevance is one of the central features used to distinguish ground from related notions such as metaphysical necessitation and logical consequence. Indeed identifying the explanatorily relevant facts responsible for

producing this or that aspect of the world is arguably the *raison d'être* of the notion of ground.

Can the virtues of structuralism mentioned above be replicated without taking ground to be plural? One might try using conjunctions in place of plurals. For the conjunction of all members of  $I_T$  — call this conjunction  $\wedge I_T$  — is (like any conjunction) grounded in its conjuncts. The structuralist then says that those conjuncts of  $\wedge I_T$  are (plurally) grounded in the members of  $Q_T$ . It follows that  $\wedge I_T$  is derivatively grounded in  $Q_T$ . One might then try replicating the virtues of structuralism without taking ground to be irreducibly plural by proposing that  $\wedge I_T$  is grounded directly in  $Q_T$  without the detour through its conjuncts. This view shares the virtues mentioned above, but it is untenable. For even if  $\wedge I_T$  is grounded directly in  $Q_T$ , it must also be grounded in its conjuncts (on pain of denying the evident truth that conjunctions are grounded in their conjuncts). And what then of those conjuncts? We cannot say of any conjunct that it is grounded qualitatively (on pain of falling foul of the arguments just given). And we cannot say that they are each grounded in the conjunction (on pain of moving in too tight a circle). So it looks like they must (on this view) be groundless. The result is that  $\wedge I_T$  is radically overdetermined: it is grounded in its conjuncts, and it is also grounded in  $Q_T$ , even though the conjuncts are not grounded in the members of  $Q_T$  or *vice versa*. This is not an explanatory thesis that should be taken at all seriously.

#### 4 Cosmic Explanations

Above, I appealed to the premise that qualitative goings-on outside our solar system are irrelevant to an explanation of Obama's existence. I said earlier why I find the premise plausible, but it might be resisted. Indeed a qualitativist wedded to singularism about ground might take the moral of the argument to be that those qualitative facts about far flung areas of the cosmos are relevant to Obama's existence after all. So let me support the premise with some argument.

Well, there is of course no *knock-down* argument to be had. We are engaged in an inference to the best explanation, so the aim is to show

that the structuralist's explanation is better than the singularist's. So let me point out various unattractive aspects of the singularist's explanation (I will point out some more virtues of the structuralist's explanation in section 9 when I discuss plural explanations in more detail).

Start with the idea that Obama's existence is grounded in  $Q_T$ . This is (as I said earlier) perhaps the most plausible example of a set of facts that necessitates Obama's existence. But what about Romney? What grounds *his* existence? Suppose we say that it is also grounded in  $Q_T$ . Then we have the absurd conclusion that Obama's existence and Romney's existence have *exactly* the same ground! Here I do not assume that distinct facts always have a distinct ground: the facts  $PvQ$  and  $PvR$  might have a common ground,  $P$ . But it is unsurprising that the disjunctions have a common ground since they have a common constituent. My point is just that in the case of Obama and Romney, it is almost unbelievable that the explanation of why the one exists is *exactly* the same as the explanation of why the other exists. Surely (this is an unargued premise) if Obama's and Romney's existence each have an explanation, there must be some differentia: some facts that play a role in making it the case that *Obama* exists but no role in making it the case that *Romney* exists (and *vice versa*).<sup>27</sup>

Where might this differentia be found? There are two options: within  $R$  or outside of  $R$ . Suppose the latter. Then there are certain qualitative goings-on in far flung corners of the universe that are relevant to explaining Obama's existence *but not Romney's*. And *this* is absurd as an explanatory hypothesis (this is another unargued premise). It is one thing to bite the bullet and say that various qualitative goings-on in Alpha Centauri are relevant to explaining Obama's existence. I could *perhaps* be persuaded of that. But it is another thing to say that such goings-on play a role in making it the case that Obama exists *but not that Romney exists*, as if Obama has his very own plot of space-time in

27. Of course the structuralist will admit that the same facts *account for* Obama's existence and Romney's existence, in the sense defined in the last section. But (as emphasized there) the notion of "accounting for" is not a purely explanatory notion. The point here is that Obama's existence must have a different *explanation* from Romney's.

far flung corners of the universe that is partially responsible for his existence but not Romney's. As an explanatory hypothesis, the idea is (frankly) hard to take seriously.

So the differentia must be found within  $R$ . This is perhaps the most plausible option available to the singularist, but it is nonetheless odd. For the intrinsic qualitative nature of  $R$  is not sufficient (on this proposal) to ground Obama's existence, facts outside  $R$  are needed too. So the view is that various qualitative goings-on outside  $R$  play a role in making it the case that Obama exists (and that Romney exists), but that various qualitative goings-on within  $R$  play *no role whatsoever* in making it the case that Obama exists. On the face of it, this looks rather bizarre — I find it hard to see what kind of serious explanatory theory would grant an explanatory role to those far-flung goings-on but not to more nearby goings-on.

Moreover it is far from clear that the proposed ground (on this proposal) would necessitate Obama's existence. For suppose that the qualitative goings-on within  $R$  that are said to be relevant to explaining Obama's existence are facts about the existence of something with just a few of Obama's qualitative properties, such as being born on a small island and being well educated. Suppose (that is) that it is just those facts within  $R$  plus the various qualitative goings-on outside  $R$  that are said to ground Obama's existence. Then the proposed ground would clearly fail to necessitate Obama's existence for the same reason that the proposals discussed in section 3 failed: it would be possible for something else within  $R$  to have those qualitative properties and yet for Obama not to exist.

Indeed this worry about necessitation arises as soon as we retreat from  $Q_T$ . So the general problem might be put like this. We cannot say that Obama's existence is grounded in  $Q_T$ , else (by parity of reasoning) we would have to say that Romney's existence is grounded in  $Q_T$  too, in which case both have exactly the same ground, which is absurd. So we have to pare down  $Q_T$  to find some core set of facts that is the ground of Obama's existence but not Romney's. But when we do so it is far from clear whether the proposed ground necessitates his existence

(and in some cases the proposed explanation is hard to take seriously in the first place).

None of this is conclusive: I have just tried to indicate some difficulties one encounters when searching for a qualitative ground of Obama's existence on its own. Insofar as structuralism avoids these difficulties, that is a point in favor of structuralism. So I leave it as a challenge to the qualitativist who wishes to ground Obama's existence on its own to develop an account that avoids these difficulties.

At this point one might reject my methodology. I appealed to premises about relevance and ground (*e.g.* my original premise that facts about Alpha Centauri are irrelevant to Obama's existence, and my premise in this section that Obama's and Romney's existence have different grounds). But it might be objected that these premises cannot be used as evidence because I have given no theory of how justified belief or knowledge about relevance or ground is possible. It is true that I have offered no such theory, but to conclude that our beliefs about relevance and ground are of no evidential significance is a gross over-reaction. If someone proposed that the occurrence of a conference is partly grounded in the number of electrons in Alpha Centauri one would reasonably reject the proposal since the latter obviously plays no role in making it the case that the event counts as a conference. Somehow — even if we know not how — our grasp of the fact that there is a conference (perhaps along with rudimentary empirical knowledge) is enough to inform us that how its participants are acting is relevant to explaining it and the number of electrons in Alpha Centauri is not. One can reasonably point this out without having a developed theory about how this is possible. I am making similar points about Obama's existence.

Moreover I do not claim that our beliefs about irrelevance and ground are indefeasible. It seems obvious that the number of electrons in Alpha Centauri is irrelevant to a *causal* explanation of why there is a conference, but there are empirical discoveries that could lead me to think otherwise (we might discover that someone formulated a plan to hold a conference on the condition that Alpha Centauri contains

more than  $n$  electrons, and then enrolled in astronomy class... ). It seems just as obvious that facts about Alpha Centauri are irrelevant to a *metaphysical* explanation of Obama's existence; but if I had good theoretical reasons to be a qualitativist and good reasons to think that the *only* way to then make sense of Obama's existence is to ground it in facts about the entire cosmos, I would consider accepting the surprising result that those facts about Alpha Centauri play a role in explaining Obama's existence after all. But this would be a radical revision of pre-theoretic belief.

And the point is that this radical revision is not required. The structuralist has no need to revise her pre-theoretic conviction that facts about Alpha Centauri are explanatorily irrelevant to Obama's existence, precisely because she denies that his existence (taken alone) has a qualitative ground in the first place. Now one might say that this comes at the cost of rejecting singularism about ground, which was also a pre-theoretic belief. But even if this was a pre-theoretic belief (which I doubt), this observation carries very little weight. For claims about the logical form of ground (like singularism) are highly abstract claims about the nature of explanation, and it is not at all clear why we should take our pre-theoretic opinions about that sort of thing seriously. So structuralism saves the pre-theoretic beliefs that matter.

### 5 The Inter-Dependence of All Things

It is worth comparing structuralism with other related views.

We already know that structuralism is not just anti-haecceitism. For (as emphasized in section 2) the latter is just a *modal* claim while the former is an *explanatory* claim.

Structuralism is a version of qualitativism, since it says that the qualitative is sufficient to ground the individualistic (so long as we are careful to hear this plurally!). But it has an important point of agreement with individualism: namely, that a given individualistic fact like Obama's existence has (when considered on its own) no qualitative ground. Admittedly, it is tempting to infer from this point of agreement that individualism is true: we have (after all)

an individualistic fact that cannot be qualitatively explained, which appears to be a counterexample to qualitativism! And indeed the inference would be valid if singularism about ground were true. Insofar as we have been in the grip of singularism, then, this might explain why individualism has traditionally been the more popular doctrine. But the inference is invalid, for even if a single individualistic fact has no qualitative ground, the individualistic facts together may (plurally) have a qualitative ground, just as the structuralist thinks.

One might object that if structuralism says that there are ungrounded facts about individuals then it is not a version of qualitativism after all. But this is mistaken. For the idea behind qualitativism is that everything arises out of purely qualitative facts, that (to use the popular metaphor) all God had to do when making the world was fix the qualitative facts. And this is indeed the case according to the structuralist. It is just that those qualitative facts explain the individualistic facts all at once, not one by one.

Perhaps the most familiar version of qualitativism is the famous bundle theory, on which each individual is identified with a set of compossible qualitative properties. This is rather different from structuralism. For while the bundle theorist sees a certain set of compossible properties and says 'Here is Obama!', the structuralist sees no such thing. For the structuralist, no part of the qualitative nature of the world can be said to be responsible for *Obama's* existence.

Is structuralism (as defined here) what "ontic structural realists" like Ladyman and Ross have in mind when they talk of individuals 'whose identity and individuality are secondary to the relational structure in which they are embedded'?<sup>28</sup> It is hard to say, in part because this talk of identity and individuality are obscure in the extreme. But suppose they had in mind the idea that each individualistic fact is grounded in facts about relational, qualitative structures. Then, like the bundle-theorist, their view is that there is some qualitative body of fact responsible for

28. Ladyman & Ross (2007), p. 144.

each individualistic fact. This is precisely what the structuralist (in my sense of the term) denies.

What I call structuralism perhaps resembles a view of Spinoza's in Part I of *The Ethics*, at least on Garrett's reading.<sup>29</sup> Spinoza famously claims that the finite modes—rocks, chairs, tables—follow from the essence of God. But according to Garrett, the correct reading is that they only follow from God's essence when taken together: it is false of any single finite mode that it follows from God's essence, but it is true of them all together that *they* follow from God's essence. Substitute the qualitative nature of the world for God's essence and understand the notion of "following" in terms of ground, and you have the structuralist view described above.

Structuralism is a claim of grounds, not of semantics. So it is consistent with a compositional semantic theory that assigns a truth-condition to each individualistic sentence on its own. For example, structuralism is consistent with a compositional semantic theory on which 'Obama is sitting' is true in English iff Obama is sitting, or iff Obama instantiates the property referred to by 'sitting' or what have you. So the mere fact (if it is one) that there are correct semantic theories of this type is no threat to structuralism.

What structuralism *may* imply is that there are no truth-conditions for a single individualistic sentence in *fundamental* (*i.e.* qualitative) terms. Whether structuralism implies this depends on what is meant by a truth-condition (equivalently: what is meant by the connective 'iff' in a statement of truth-conditions). But even if it implies this, there is no conflict with the project of semantics, for it is no part of that project to state truth-conditions in fundamental terms (if you doubt this, go and count how many semantic theories are stated in the language of quantum mechanics).<sup>30</sup> Moreover it may nonetheless be possible

29. See Garrett (1991).

30. The point here amounts to Sider's distinction between a "linguistic semantics" and a "metaphysical semantics" (see his Sider [2011]). The former is what gets done by linguists and contemporary philosophers of language, in which a semantics for (say) the term 'football match' would not be expected to be given in terms of the underlying quantum mechanical states that make it up such

to take a set of individualistic sentences together and state the truth-conditions for *them* in fundamental (*i.e.* qualitative) terms (again, I hedge because this all depends on what is meant by a truth-condition). The resulting semantics would be holistic, delivering a truth-condition for *them* without delivering one for any member of the set taken alone. Which is precisely the kind of semantics in fundamental terms that a structuralist would expect.

### 6 Absolutism and Comparativism

So much for individuals. Perhaps surprisingly, an analogous structuralist view can be motivated with similar arguments about what is on the face of it a very different case, namely that of quantities like mass, charge, energy, temperature, length, and so on. I will focus on the case of mass, but the discussion generalizes to other quantities.

Let us start by distinguishing two views about mass. The property of having mass is a determinate that appears to have two kinds of determinates. It is natural to think that something with mass has a determinate *intrinsic* property, a property it has independently of its relations to other material bodies. But it is also natural to think that things with mass stand in various determinate *mass relationships* with one another, such as  $x$  being more massive than  $y$  or  $x$  being twice as massive as  $y$ .

Now, of the intrinsic masses and the mass relationships, which are fundamental? According to a view I will call *absolutism*, the intrinsic masses are prior to the mass relationships. The absolutist does not deny that things stand in determinate mass relationships, she just says that those relationships — and indeed all facts about the masses of material bodies — are derivatively grounded in facts about the particular intrinsic mass had by each body. If my laptop is more massive than my cup, the absolutist will say that this is because of the

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matches. In contrast, a compositional semantics stated in those fundamental terms is what Sider calls a “metaphysical semantics”. In the text, I am using ‘semantics’ to refer to what Sider calls linguistic semantics.

intrinsic mass that they each possess.<sup>31</sup> In contrast, *comparativism* is the view that all facts about the masses of material bodies are derivatively grounded in facts about how they are related in mass to one another. Some comparativists will say that the most fundamental mass relations are ratio relations while others will insist that they are merely ordinal, but this in-house dispute will not concern us here.<sup>32</sup>

I favor comparativism. My reason is analogous to my reason for favoring qualitativism. The rough idea is that all we can ever observe are the mass relationships between things, for example that one body is more massive than another. If, as the absolutist claims, there are further facts of the matter concerning which particular intrinsic mass each body has — facts that are not grounded in those mass relationships — then those facts lie beyond our epistemic ken. A reasonable Occamist principle then recommends that we dispense with such epistemically inaccessible facts.<sup>33</sup>

However, my aim here is not to argue for comparativism but to argue that *if* comparativism is true, then certain facts about mass must be grounded plurally in mass relationships rather than one by one. I have in mind facts about mass in a given scale, such as that my laptop is 2 kilograms, that Beckham is 75 kgs, and so on. The comparativist faces the challenge of showing that mass relationships really are sufficient to explain these kilogram facts. If she cannot meet this challenge, then she would have to be an eliminativist about kilogram facts and claim that there are no such facts. Insofar as this is intolerable, meeting the challenge is crucial to the success of comparativism. I will argue that the comparativist faces significant difficulties if she attempts to ground

31. And, perhaps, facts about how the intrinsic masses themselves are related to one another. The details of the view can be cashed out in many different ways, but these differences will not matter in what follows. Absolutists include Armstrong (1988), Eddon (2013), and Mundy (1987).
32. For a more precise account of the distinction between absolutism and comparativism, see Dasgupta (2013).
33. Like the Occamist argument against individualism there is much more to say here. I say some of it in Dasgupta (2013).

each kilogram fact in turn, but that these difficulties dissolve if she grounds them plurally.

Before we start, note that the absolutist can very easily explain each kilogram fact on its own. For if material bodies have the intrinsic masses posited by the absolutist, it is plausible that terms of the form '*r* kilograms' would refer to those properties. If so, then it is almost irresistible to say (for example) that my laptop's being 2 kgs is grounded in (or perhaps even identical to) its having a certain intrinsic mass; namely, that intrinsic mass that is the referent of '2 kilograms'.

### 7 Finding Kilograms in a Comparative World

So the absolutist has what appears to be an attractive explanation of each kilogram fact on its own. Not the comparativist, though. To see this, consider the fact that my laptop is 2 kgs. If the comparativist tries to ground this fact in mass relationships, she must find some set *R* of facts about mass relationships that explains its being 2 kgs. But what could *R* be? I will argue (as before) that any candidate set *R* that might *necessitate* my laptop's being 2 kgs contains *irrelevant* information. Once again we have a case in which my two assumptions — that a ground must both necessitate and be relevant to what it grounds — cannot be jointly satisfied.

Let us start by constructing a candidate set *R*. The most obvious suggestion is to let *R* be the single fact that my laptop is twice as massive as the standard kilogram in Paris, often known as the International Prototype Kilogram (IPK). But the trouble is that this does not necessitate the fact that my laptop is 2 kgs. For it is possible for my laptop and IPK to both be twice as massive as they actually are, in which case my laptop would still be twice as massive as IPK and yet would be 4 kgs, not 2 kgs.

What other mass relationships might necessitate my laptop's being 2 kgs? It would not help to add to *R* facts about the mass ratio between my laptop and (say) twenty other benchmark items, since the same kind of argument shows that those relationships do not necessitate my laptop's being 2 kgs either. But what if we let *R* contain facts about

how my laptop is related in mass to *all* other bodies in the entire cosmos: would *R* then necessitate my laptop's being 2 kgs? It is not clear. *R* would fix the mass relationship between *any* two bodies, so the question is whether the entire cosmos could be exactly as it is in all mass-relational respects and yet differ in the mass of my laptop, and I do not have a clear intuition either way.

However, we are arguing that *if* comparativism is true then the kilogram facts are plurally grounded, and it follows from comparativism (and our assumption that grounded is necessitated by its grounds) that the mass relationships necessitate any fact about mass. So denying that *R* necessitates my laptop's being 2 kgs is not dialectically available. So assume that *R* would necessitate my laptop's being 2 kgs. The trouble is that *R* would contain explanatorily irrelevant information. It would contain facts about the mass relationship between my laptop and electrons in Alpha Centauri, and (premise) these are irrelevant to explaining my laptop's mass in kilograms. Surely its mass relationships to electrons in Alpha Centauri play no role in making it the case that it is 2 kgs.

This premise might be resisted, but it is very plausible. It can also be supported with argument. For recall how natural it was for the absolutist to ground my laptop's being 2 kgs in terms of its intrinsic mass: that intrinsic property (if it had such a thing) would explain its being 2 kgs. This explanation is not available to the comparativist, but the fact that it is so natural suggests that we (pre-theoretically) take facts about electrons in Alpha Centauri to be irrelevant to the matter.

Indeed this last point might be turned into an objection to *any* appeal to mass relationships, even mass relationships to IPK. The argument would start with the observation that we find the absolutist's intrinsic explanation so satisfying. And it would argue that this is evidence that we (pre-theoretically) take my laptop's mass relation to *any* other body (including IPK) to be explanatorily irrelevant to why it is 2 kgs. Perhaps its relation to IPK is relevant to explaining the *semantic* fact that '2 kgs' picks out the intrinsic mass it does, but not (according to this argument) the *non-semantic* fact of my laptop's being



2 kgs. The argument has some appeal. After all, the absolutist *could in principle* appeal to my laptop's relation to IPK when explaining why it is 2 kgs, but if she did then her resulting explanation would look decidedly odd. One would ask why she brought IPK into the picture when all that appears relevant is its intrinsic mass. If we accept this argument, then *any* comparativist explanation of its being 2 kgs — even the initial suggestion in terms of its being twice as massive as IPK — is objectionable on the basis that it appeals to what we pre-theoretically take to be irrelevant information.<sup>34</sup>

This is important. For one might have tried to refine that initial suggestion in light of the modal objection to it discussed earlier. One might have said that my laptop's being 2 kgs is grounded in its being twice as massive as IPK *actually* is. Or one might have developed a view according to which it is impossible for IPK to have differed in mass at all: while the lump of metal in Paris could have been more massive (the idea would be) IPK should not be identified with that lump and is instead a co-located yet distinct object that has its mass essentially.<sup>35</sup> The modal objection would have no force against either of these views, but according to the above argument both views are objectionable since they appeal to what we take to be irrelevant information, namely my laptop's mass relationship to IPK.<sup>36</sup>

34. One might respond to this argument by saying that if comparativism is true, then the mass relations *must* be relevant, since they are all the comparativist has to work with. But this ignores the possibility of error theory. For the comparativist might concede the argument in this paragraph and conclude that since there is no grounding my laptop's being 2 kgs in terms that she recognizes, there is no such fact. To say that the comparativist *must* ground its being 2 kgs in mass relationships is akin to claiming that being a witch *must* be explicable in natural terms, since natural facts are all we have to work with.

35. Thanks to Jack Spencer for bringing this view to my attention.

36. To be clear, both the refined views in the last paragraph are vulnerable to another (perhaps more decisive) objection. The objection is that they both appeal to the intelligibility of mass comparisons across different possible scenarios, and yet it is doubtful that this is intelligible to the comparativist. But the issue of cross-world mass comparisons is delicate and it would be distracting to discuss it here (I discuss it at some length in section 10). So for now I rest my objection to these views on the charge of irrelevance.

As before, this belief that relations to other things are irrelevant — be they relations to IPK, or to electrons in Alpha Centauria — is not sacrosanct. If I had good theoretical reasons to be a comparativist and if the *only* way to then make sense of my laptop's being 2 kgs were to ground it in its relationships to IPK, for example, I would consider revising that belief. But the virtue of plural grounding is that no revision is required.

### 8 Structuralism Redux

How so? One simple proposal is to let K be the set of all kilogram facts and let R be the set of all fundamental facts about mass relations, and then say that the members of K are plurally grounded in the members of R even though no member of K is grounded in any subset of R. Call this a *structuralist* view of kilograms, since an explanation of any kilogram fact is (on this view) inevitably an explanation of them all. As in the case of individuals there are many details to argue about: whether R should include only certain kinds of mass relations such as ratio relations, whether K should include only those facts concerning the mass in kilograms of the fundamental particles, and so on. But these are all in-house arguments between theorists all of whom deserve to be called structuralists. Since their differences will not matter here I will focus on the simple proposal described above.

An advantage of structuralism (as before) is that it dissolves the problems we faced when trying to ground my laptop's being 2 kgs on its own. For one thing, R contains no irrelevancies when it comes to explaining the members of K. Sure, R contains irrelevancies when explaining my laptop's being 2 kgs, such as mass relationships between electrons in Alpha Centauri. But since K contains kilogram facts about those very electrons, the relationships between them are certainly relevant when explaining K's members! And as we just saw (when discussing the idea that R grounds my laptop's mass in kgs) it is not implausible that R necessitates K. (Moreover, if one denies that R necessitates K then one denies comparativism, and here I am trying to establish that *if* comparativism is true, *then* the kilogram facts

are grounded plurally in the mass relations.) So our problems dissolve when we instead ground kilogram facts plurally.

This does not imply that structuralism is the best form of comparativism, but it is evidence in its favor.

Though structuralism is a version of comparativism, it has an important point of agreement with absolutism: namely, that a given kilogram fact has (when considered on its own) no relational ground. It may be tempting to infer from this point of agreement that absolutism is true, and indeed the inference would be valid if singularism about ground were true. Insofar as we have been in the grip of singularism, then, this might explain why absolutism has traditionally been the more popular doctrine. But the inference is invalid: even if the kilogram fact has no relational ground on its own, it may be that the kilogram facts together have a relational ground (just as the structuralist says).

I have focused on the case of mass but I expect that the lessons here generalize to other cases in which we have a mathematical representation of worldly phenomena, for example a representation of distance in meters, time in seconds, acceleration in meters-per-second-squared, rational preferences in utils, and so on. In all these cases I believe that the facts about the mathematical values in a given scale will be *plurally* grounded in the underlying facts that give rise to the numerical representations. If that is right then we have here a general method of approaching the metaphysics of numerical representation, not just mass. But I leave the generalization to other cases for another time.

## 9 Structural Explanations

So far I have argued that each structuralist view dissolves problems that we faced when attempting to ground each individualistic fact or each kilogram fact alone. But it is one thing to say that the views dissolve certain problems, it is another thing to show that the structuralist's proposed explanation in each case really is explanatory, *i.e.* that the underlying mass relations in R really are sufficient to explain the

plurality of kilogram facts in K, and that the underlying qualitative facts in  $Q_T$  are really sufficient to explain the individualistic facts in  $I_T$ .

Focus on the case of kilograms, where I think the worry is most pressing. The structuralist says that the total body of mass relations explains why my laptop is 2 kgs, my table is 10 kgs, my bed is 100 kgs, etc. But it is consistent with those relations that my laptop is 4 kgs, my table 20 kgs, my bed 200 kgs, etc. The worry is then that a mere description of the mass relations has missed something out and has not explained why the kilogram facts are as they are rather than (say) double what they are.<sup>37</sup>

One might respond with abstract argument. For example, one might argue for the general principle that if some Xs are relevant to some Ys and necessitate those Ys then the Xs ground those Ys. For it is almost undeniable that the relations in R are relevant to the kilogram facts in K. And (as I said in section 8) we are assuming that R necessitates K.

But even if this abstract argument has some merits, something more illuminating can be said to make the structuralist's explanation compelling. The key is to recognize that the basic role of kilogram predicates in our language is to conveniently store information about mass ratios. Once that role is clearly in view, the structuralist's explanation becomes compelling and the idea that something has been missed out evaporates.

37. Care is needed in formulating the worry. One way to put it is that R does not single out a particular material body as privileged and so does not "fix a unit kilogram". But this way of putting the worry is confused. For consider the standard absolutist view according to which a given material body's being  $r$  kgs is grounded in its having a certain intrinsic mass. On this view the proposed grounds — *i.e.* facts about which intrinsic mass each material body has — do not single out any particular material body as privileged and so in *that* sense do not fix a unit kilogram either. What then does it *mean* to fix a unit? Presumably the idea is that the expression '1 kg' is stipulated to refer to that intrinsic mass had by the IPK, and so the IPK is then said to be of unit mass on the kilogram scale. But if *that* is the question of how a unit is fixed then it is a meta-semantic question about what determines the meanings of our words, not a question about what grounds the kilogram facts. So neither absolutism nor structuralism should be expected to answer it.

To show this, let me first describe a fictional community in which their predicates are stipulated to play exactly that role and then show that the structuralist's proposed explanation is compelling when it comes to explaining the facts that *they* express with their predicates. Then I will argue that our own community is just like theirs in all relevant respects.

Consider then a community that initially lacks kilogram predicates. Let us imagine that the only expressions they have with which to talk about mass are predicates of the form ' $x$  is  $r$  times more massive than  $y$ ', one for each positive real  $r$ . If comparativism is true then their language is complete in the sense that they can state all the fundamental facts about mass. Nonetheless, their language is somewhat impractical: if one of their citizens Rahul is hosting a pot-luck dinner and wants everyone to contribute half the amount of rice in his cupboard, the only way he can issue the request is to say something like 'Please could everyone bring half the amount of rice in my cupboard'. Each guest would then need to visit Rahul's house before the party to measure out the right amount.

So it behooves them to find some way of attributing mass to things one by one, as it were, so that they could all have determined the right quantity of rice at home. The important thing is that these attributions should be coordinated so that they imply the mass-ratios that they are interested in. To this end, Rahul introduces a slew of one-place predicates of the form ' $x$  is  $r$  Dravids' into the language, one for each positive real  $r$ . His idea is that the ratios between real numbers can then be used to represent the mass-ratios between the material bodies. Since this is the primary function of these predicates the only thing that Rahul says when introducing them is that they are governed by the following inference rule:

$x$  is  $r$  Dravids

$y$  is  $s$  Dravids

---

Therefore,  $x$  is  $r/s$  times as massive as  $y$

His idea is the members of his community should go forth and apply these predicates to material bodies in such a way that each application "coheres" with other applications made in their community — coheres, in the sense that inferring by the above rule yields truths about mass-ratio. So a speaker's primary aim in applying one of the predicates is just that her application coheres with a (perhaps weighted) majority of the other applications in her community.

It does not matter how the practice gets going: the very first speaker has free rein to apply any of the predicates to any object! But once this first application is made the above inference constrains subsequent applications by other speakers. So the community is now faced with a coordination problem. But this is easily solved by distributing Dravid-measuring instruments to the population that are all calibrated with one another — calibrated, in the sense that they are all designed to assign numbers to things in such a way as to cohere in the above sense.<sup>38</sup>

38. Their practice will only work, note, if it is possible to assign numbers to material things in a coordinated manner. This is confirmed by a so-called *representation theorem* of measurement theory. Say that a function  $f$  from material things to real numbers *represents mass-ratio* iff the following is true:  $x$  is  $r$  times more massive than  $y$  iff  $f(x) = r.f(y)$ . Then a representation theorem states that if the mass-ratios between things obey various constraints then there is at least one function that represents mass ratio. It follows that there exist applications of Dravid predicates to things that cohere in the sense mentioned in the text.

The so-called *uniqueness theorem* then states that given any function  $f$  that represents mass ratio, (i)  $r.f$  also represents mass ratio, for any positive real  $r$ , and (ii) every function that represents mass ratio can be written as  $r.f$ , for some positive real  $r$ . The representation and uniqueness theorems together imply that given *any* material body and *any* real number, *there is a unique* function that maps that body to that number and that represents mass-ratio. Which means that the first speaker does indeed have free reign to apply any of the predicates to any object, sure in the knowledge that it is possible for the community's other applications of Dravid predicates to cohere with that first application.

Now I just slurred over many details of the representation and uniqueness theorems. For one thing, these theorems are usually stated with respect to an underlying relational language that contains just two predicates: ' $x$  is greater or equal in mass than  $y$ ' and a predicate for material composition. But this simplification is harmless for current purposes. For more realistic theorems and proofs see Krantz *et al.* (1971).

Having introduced these predicates, Rahul's life is much easier. If his own Dravid-measuring instrument says that he has 2 Dravids of rice in his cupboard, he can simply ask each of his guests to bring 1 Dravid of rice and it will then follow (so long as the instruments are calibrated) that each guest will bring half the amount of rice in his cupboard, as desired.

Importantly, note that in introducing his predicates Rahul said *nothing* about a "standard object" in terms of which the term '1 Dravid' is defined or has its reference fixed. All that matters (given what Rahul said) is that their Dravid-measuring instruments are calibrated in the above sense — it does *not* matter whether they are all calibrated with a special "standard object". Of course, if the community all agrees that a particular bag of rice is 1 Dravid, then they might put that bag in a (protected) public space and use it as a practical aid in calibrating their Dravid-measuring instruments. But there is no requirement that they define or fix the reference of '1 Dravid' in terms of that bag. So, if they discovered that the bag is actually half as massive as they thought it was, they would not be required by the semantics of 'Dravid' to continue to think that it is 1 Dravid come what may. Rather — as long as they were still confident that their Dravid-measuring instruments were calibrated — they would say that the bag is actually 0.5 Dravids (and they might then use some other object to help calibrate their devices instead). The point is that the bag would just be a (dispensable) practical aid used to further the primary goal of coordination.

Now suppose that the Dravid predicates become deeply entrenched in Rahul's community, in the sense that the community has applied the predicates widely and there is a (perhaps weighted) core majority of those applications that cohere with one another. Then I claim that a structuralist explanation of Dravid facts — *i. e.* of what is expressed by applications of Dravid predicates — is almost irresistible. To see this, suppose Rahul asserts one of those applications in the coherent core, say, 'This brick is 2 Dravids.' And suppose as comparativists we then ask Rahul what it is *about the underlying mass-ratios* that make the brick 2 Dravids. Then there would appear to be no answer. Remember,

there is no privileged "standard object", such that something can be said to be 2 Dravids in virtue of being twice as massive as *it*. Given the role of Dravid predicates in their language, it seems that *if* there is an explanation of why the brick is 2 Dravids, it is that the brick's being 2 Dravids coheres with the mass-in-Dravids of other things — but since this answer appeals to the mass-in-Dravids of other things it is not an answer that is acceptable to the comparativist. So the brick's being 2 Dravids appears to have no purely mass-relational ground on its own.

But now take the coherent core set of applications and add the as-yet unaccepted sentences of the form '*x* is *r* Dravids' that cohere with that core, one sentence for each material body *x*. The resulting set of sentences *D* is a complete representation of mass, in the sense that one could recover the entire mass relational nature of the world from its members by way of the above inference scheme. And now suppose Rahul asserts each member of *D* in turn — 'This brick is 2 Dravids, my table is 10 Dravids, David Beckham is 75 Dravids...' — and suppose that when he is done (!) we ask him to explain what makes all that the case. Well, since his primary aim in applying the predicates is just that his applications cohere in such a way as to represent the mass ratios between things, it is almost irresistible to say that what he said (when he asserted the members of *D*) is the case *because* of the underlying mass relationships between the material bodies. Indeed, if the role of Dravid predicates is just to store and communicate information about mass-ratio, it is hard to see what else could possibly be needed to explain the mass-in-Dravids of things!

This is structuralism through and through: the Dravid facts taken together are explained in terms of the underlying mass relationships, but no Dravid fact on its own has a mass relational ground. To be clear, this structuralist view of Dravids is not *logically implied* by the way Rahul uses his predicates, but it does strike me as almost irresistible — or at any rate the best explanation going.

I believe that the community I just described is in all important respects ours: we use kilogram predicates just as Rahul uses Dravid predicates. The primary role of our kilogram predicates is just to

conveniently store information about mass-ratio, so our primary aim in applying them is that our applications cohere with a (perhaps weighted) majority of the other applications in our linguistic community. “Standard objects” like the IPK in Paris are nothing other than practical aids at achieving global coordination. Once we see this, the structuralist explanation of what we express with kilogram predicates—*i.e.* the kilogram facts—is just as compelling and irresistible as the structuralist explanation of the Dravid facts.

What can prevent us from seeing this, though, are misguided theories about the role of “standard objects” like IPK, which invite us to think that each kilogram fact ought to have a ground on its own. For example, consider the view that ‘*x* is *r* kilogram’ is *defined* to be true of an object *x* just in case *x* is *r* times more massive than IPK. This view encourages the idea that a given object’s being *r* kgs has a ground on its own, namely in terms of its being *r* times more massive than IPK. But as Kripke famously argued, this view about kilogram predicates is false: it has the incorrect consequence that IPK is necessarily 1 kilogram.<sup>39</sup>

Or consider the Kripkean view that we use each term of the form ‘*r* kilograms’ with the reference-fixing stipulation that if it is to refer to anything, it is to refer to the mass that is *r* times that mass had by IPK.<sup>40</sup> On this view IPK is not part of the semantics of ‘kilograms’, but it is part of the meta-semantic theory about how the referent of ‘*r* kilograms’ is fixed. Still, this view also encourages the idea that each kilogram fact has its own ground, this time in terms of the intrinsic masses referred to by terms of the form ‘*r* kilograms’.

But this Kripkean view is false. To see this, imagine reading in the Times that there is in fact no special lump of metal in Paris known as IPK and that the French created the illusion of such a lump with an elaborate system of lights and holograms. The article explains that the illusion was systematic, so that whenever we thought we were using

IPK to calibrate various measuring instruments with one another the calibration succeeded even though we were misled about the existence of the lump. How would we report the discovery? Presumably just by saying that IPK (surprisingly) does not exist, and not much more. Importantly, if I had previously believed that my laptop is 2 kgs, then I would not revise that belief in light of the discovery: I would continue to believe and assert that my laptop is 2 kgs even though there is no special lump in Paris. But the Kripkean view has difficulty explaining this datum. For the view implies that if it turns out that there is no such thing as IPK then terms of the form ‘*r* kilograms’ fail to refer, and it is then difficult to see why I would be inclined to continue to say that my laptop is 2 kilograms.

A second case is perhaps more telling. This time, imagine reading in the Times that while there is such a thing as IPK, it turns out that the French have been creating an elaborate illusion designed to make us think that it is twice as massive as it actually is. Again, the article tells us that the illusion was systematic, so that the measuring instruments around the world that were calibrated with the help of IPK are indeed all calibrated with one other. The only surprise is that if we were to put IPK on any one of them we would get a reading of ‘500 grams’, not ‘1 kg’ as expected. How would we report this discovery? Presumably by saying something like ‘Wow, it turns out that the standard kilogram in Paris is actually 500 grams!’ In particular, if asked how massive my laptop was I would be inclined to say ‘It is 2 kgs, this article has no bearing on that question.’ But the Kripkean theory predicts otherwise. For that theory says that ‘1 kilogram’ is stipulated to refer to the mass of IPK *whatever that mass is*, so it implies that the article should instead be reported as telling us that while the standard object is (of course) still 1 kg, it turns out that my laptop is (surprisingly!) 4 kgs after all. And this is not how we would report it.

I just discussed two views that give standard objects like IPK a central role in the semantics or meta-semantics of ‘kilograms’. Each view encourages the impression that each kilogram fact has a ground

39. See Kripke (1972).

40. Again, see Kripke (1972).

of its own. But each view is false. Seeing that they are false therefore removes obstacles to seeing the virtue of structuralist explanations.

The correct view, I said, is that we use of kilogram predicates just like Rahul uses his Dravid predicates. This view predicts our reactions to the two stories in the Times just discussed, which is evidence that it is true. And once we see that it is true, the structuralist explanation of kilogram facts — *i. e.* the facts we express with kilogram predicates — is just as compelling as the structuralist explanation of the Dravid facts.

To be clear, you do not need to endorse this view of kilogram predicates to endorse structuralism. But I have tried to motivate it because it removes obstacles from appreciating the structuralist's explanation (*i. e.* by minimizing the role of IPK in kilogram talk) and so makes it plausible that the underlying mass relations really are sufficient to explain the kilogram facts.

I should emphasize that this view about how we use kilogram predicates is consistent with compositional semantic theories that assign truth-conditions to each kilogram sentence on its own. With regards to Rahul's language, we might say that '*x* is 2 Dravids' is true in the language of Rahul's community iff *x* is 1 kilogram, or iff *x* is 2.2 pounds, or what have you. Indeed once their use of Dravid predicates became deeply enough entrenched, truth-conditions of this kind would appear to be highly plausible. And the existence of truth-conditions like this is consistent with the structuralist's claim that no kilogram fact has a ground in purely mass-relational terms (this is the analogue of the point I made in section 5 regarding structuralism about individuals).

I have discussed the case of kilograms, but I believe that roughly the same goes for individuals. Just as kilogram predicates are devices of measurement whose primary role is to conveniently store information about underlying mass-ratios, so too are singular terms "devices of measurement" whose primary role is to conveniently store information about the underlying qualitative world. And just as kilogram predicates fulfill their function by being governed by the canonical inference described above, so too our singular terms are governed by the introduction and elimination rules for the existential

quantifier, rules which allow them to fulfill their role of allowing us to conveniently reason about what is ultimately a purely qualitative world. I develop this view of singular terms in Dasgupta (2009), but there is no space to discuss it here. Still, if it is right, then it helps us see that the structuralist's explanation of individualistic facts in terms of qualitative facts is extremely plausible.

### 10 Modal Problems?

The last section argued that the structuralist's proposed explanation of kilogram facts (and individualistic facts) is compelling. Still, one might think that it cannot be correct since it is subject to devastating problems. There is of course no space to consider every potential problem, but let me discuss two that concern structuralism's modal implications.<sup>41</sup>

The first objection notices that if my laptop is in fact 2 kgs, it is nonetheless possible for it to have been 4 kgs and yet for everything else's mass in kilograms to have remained the same. The possibility of this "independent variation" is evidence (the objection goes) that my laptop's mass in kilograms has a ground all on its own which can vary independently of the grounds of the mass in kilograms of other objects, *contra* structuralism.<sup>42</sup>

The second objection accuses the structuralist of not being able to make sense of any possibilities concerning mass in kilograms in the first place. To see this, consider the possibility just mentioned of my laptop being 4 kgs instead of 2. Why think that the structuralist can make no sense of this? She can make sense of a world *W* that is just like ours with the one exception that the mass-ratio between my laptop and all other things is double what it actually is. But the worry is that on the structuralist's own lights there is no fact of the matter as to whether *W* is a world in which my laptop is 4 kgs, or one in which

41. I focus on these just because they are the objections I have most often encountered when talking about structuralism.

42. Thanks to Richard Chappell and Brad Weslake for helping me appreciate the force of this objection.

it is 2 kgs and everything else is half the mass in kgs that they actually are. For the structuralist is a comparativist who thinks that all facts about mass are grounded in mass relationships, and the problem is that those mass relationships do not fix how the bodies in the actual world are related in mass to those in *W*. And if there is no fact of the matter as to whether my laptop in *W* is more massive than my laptop actually is, the worry is, there can be no fact of the matter as to what its mass in kilograms is in *W*.

I believe that both objections can be answered: we can make sense of possibilities concerning mass in kilograms (answering the second) and the way we do this will imply that my laptop could have been 4 kgs even if everything else's mass remained the same (answering the first).

So let us start with the second objection. One response is to endorse modal realism and say that the fundamental facts about the world are really facts concerning a plurality of worlds. The comparativist may then think that the fundamental facts concerning mass relationships include how objects in different worlds relate to one another in mass.

But one might find the idea of inter-world mass relations repugnant so let me outline another response that does not appeal to them.<sup>43</sup> This response accuses the argument of using an incorrect model of how a possible world represents my laptop's mass and introduces a better model that allows her to make sense of the possibility in question. First, how does a possible world represent something *de re* of my laptop in the first place? Lewis famously said that it does so not by containing my laptop itself but instead by containing one of its counterparts. It does not matter for our purposes whether he was right about this, but let us assume that he was so that we have a working model of *de re* representation in play. Given this assumption, the world *W* introduced above can be redescribed as a world containing counterparts of my laptop and every other material body *x* such that if my laptop is *r* times as massive as *x*, my laptop's counterpart in *W* is *2r* times as massive as *x*'s counterpart in *W*.

43. The presentation here overlaps with Dasgupta (2013).

Now, is there anything about *W* in virtue of which it can be said to represent my laptop's being 4 kgs? Well, notice that the mass ratios that my laptop enters into differ systematically from those that its counterpart in *W* enters into, by a factor of 2. That is, if my laptop is *r* times more massive than another object *x*, then my laptop's counterpart in *W* is *2r* times more massive than *x*'s counterpart in *W*. In contrast, consider any object other than my laptop, like my printer. The mass ratios it enters into are almost exactly the same as its counterpart in *W*. The *only* difference concerns its relation to my laptop: while my printer is (say) twice as massive as my laptop, my printer's counterpart in *W* is the same mass as my laptop's counterpart in *W*. So my laptop and my printer differ in this respect: my printer's mass role is very similar to the mass role of its counterpart in *W*, but my laptop's mass role is systematically different from that of its counterpart in *W*, by a factor of 2. So we might say that it is in virtue of this difference that *W* represents my laptop as being twice as massive as it actually is and everything else as having the same mass that they actually have. The structuralist can then piggy-back on this, for if *W* represents my laptop as being twice as massive as it actually is and if my laptop is actually 2 kgs, then we can take *W* to represent my laptop to be 4 kgs.

In effect, we just introduced a "mass-counterpart" relation in addition to the ordinary, Lewisian counterpart relation. Since my printer and its counterpart in *W* resemble one another with respect to their mass role, let us call them mass-counterparts. And (the idea is) because my printer's counterpart in *W* is also its own mass-counterpart, *W* represents my printer as having the same mass as it actually is. Here the mass-counterpart relation is doing analogous work to Lewis' counterpart relation: just as the latter is not identity but instead stands in for it when determining what a world represents *de re*, the mass-counterpart relation is not the same-mass-as relation but instead stands in for it when determining what a world represents about mass. And like Lewis' counterpart relation, those aspects of an item's mass-relational profile important to determining its mass-counterparts will presumably depend on the conversational context.

With a bit of conversational coaxing we might engineer a lax enough context in which my laptop's counterpart in *W* is also its own mass-counterpart; and relative to this mass-counterpart relation *W* will represent my laptop as being 2 kgs and everything else as having half the mass in kilograms that they actually have!<sup>44</sup>

Lewis' counterpart theory is often seen as a reduction of *de re* modality in terms of *de dicto* modality. We can similarly see the mass-counterpart theory just described as a reduction of modality concerning mass in kilograms in terms of modality concerning mass ratios. We can therefore distinguish between two senses of possibility: a fundamental sense that just concerns variations in mass ratios, and a looser sense that (also) concerns variations in mass in kilograms. So the structuralist should concede that in the fundamental sense of possibility, the objections under discussion are well taken. But she can say that there is a looser sense of possibility whereby possibilities concerning mass in kilograms are explained in terms of possible worlds concerning mass ratios in the above way. And so she can agree that (in many contexts) it is possible in this loose sense for my laptop to have been 4 kgs even while all other things have the same mass in kilograms that they actually have, thereby answering the two objections.<sup>45</sup>

44. I develop this mass-counterpart theory in more detail in Dasgupta (2013).

45. Earlier I assumed that grounds necessitate what they ground. Having distinguished these senses of possibility the question arises as to which notion of possibility makes this assumption true. Is it the fundamental sense or the reduced sense? And if the latter (context sensitive) notion, what are the relevant contexts? This is a deep question, but it is beyond the scope of the current paper so I will not try to settle it here. It suffices for current purposes to describe the sense of 'necessary' relevant to that assumption by pointing to paradigm examples of ground: that the occurrence of a conference is grounded in the actions of its participants, that the existence of a table is grounded (say) in the existence and arrangement of various particles, and so on. The relevant sense of necessity is then the sense in which those grounds intuitively necessitate what they ground. So it is the sense in which it is impossible for the participants to act like that and not be participating in a conference, and in which it is impossible for the particles to be arranged like that and there not be a table, and so on. So when I said that the qualitative goings-on in our solar system do not necessitate Obama's existence or that my laptop's

## 11 Pluralism and Symmetry

I have argued that *if* the world is fundamentally qualitative *then* the individualistic facts are plurally grounded in the qualitative. I also argued that *if* mass is fundamentally relational *then* the kilogram facts are plurally grounded in those mass relations. Both claims are conditional so the arguments did not purport to show that there are actual cases of plural grounding. But they do suggest that the consequents of the conditionals are coherent and intelligible hypotheses that are worth taking seriously. So our view about the logical structure of ground should allow for them: we should be pluralists and think that the logical form of a claim about ground is irreducibly plural, *i. e.* that *they* are grounded in *them*.

One consequence is that we need to take care when linking ground with fundamentality. Schaffer (2009) says that a fact is fundamental iff it has no ground. But this is problematic if one also thinks that the fundamental facts are (pictorially speaking) those that lie at the bottom of the "great chain of being", those that (as the metaphor goes) God had to determine when making the world. For if pluralism about ground is correct, then a fact may have no ground but be part of a plurality of facts with a ground. In this case, the fact would count as fundamental in Schaffer's sense, but is not something that God had to determine when making the world and so (in the relevant sense) does not lie at the bottom of the "great chain of being". If one wants to use the word 'fundamental' to track facts at the bottom of the great chain, one should say instead that a fact is fundamental iff it is not one of a plurality with a ground. So we should distinguish two senses of fundamentality: one (Schaffer's) tracks those facts without grounds, while the other tracks those facts at the bottom of the great chain. If pluralism about ground is correct, these two senses come apart.

being twice as massive as IPK does not necessitate its being 2 kgs, the claim was that they do not necessitate in *that* sense (whatever it is) — which seems true. As it happens, I believe that the notion of necessity in question may well be Fine's notion of necessity that applies to those truths that follow from the essences of things, but I leave further discussion of this point for another time. Thanks to Juhani Yli-Vakkuri for a helpful conversation on this point.



Conflating these two senses can lead to mistakes. Indeed I suspect that the conflation lies behind much of the attraction of individualism. Suppose you think that the existence of a given individual is not grounded in further individualistic facts. And suppose you think (correctly, in my view) that it has no qualitative ground either. It follows that its existence is fundamental in Schaffer's sense. If you conflate the senses of fundamentality, you will then think that its existence lies at the bottom of the great chain of being, that it is something that God had to determine when making the world. So you will think that individualism is true. But this reasoning equivocated on these senses of fundamentality. For even if its existence is fundamental in Schaffer's sense and lacks a qualitative ground, it may nonetheless be one of a plurality of individualistic facts that together have a qualitative ground. If so, then its existence does not lie at the bottom of the great chain after all; *contra* individualism. (I also suspect that a similar mistake lies behind the attraction of absolutism.)

So an important project, I think, is to identify occurrences of this kind of mistake, as I tried to do earlier in the case of individuals and kilograms. Other mistakes can stem from failing to recognize that ground is irreducibly plural too. I will finish by identifying one. It involves a famous argument against qualitativism that turns out to be unsound if pluralism about ground is true. The first premise of the argument states that the "Max Black" world discussed in section 2 is possible, *i. e.* that it is possible for there to be just two spheres of iron located 2 miles apart which share all their qualitative properties (they are of exactly the same mass, color, shape, etc). The second premise is that the qualitativist cannot make sense of this possibility. I will argue that the second premise is false if pluralism about ground is true.<sup>46</sup>

To see this, start by asking how the second premise is to be justified. One question is whether the qualitativist has the resources to describe the *fundamental*, qualitative facts of a Max Black world. As we saw in section 2, some qualitativists appear to be unable to do this. For

46. This is not the only available response to the argument. See Hawley (2009) for a discussion of others.

example if the traditional bundle theorist's view is that the underlying qualitative facts *just* concern which intrinsic, qualitative properties are compresent, it is difficult to see how she can describe a situation in which there are *two* individuals with the same such properties. But (again as we saw in section 2) other qualitativists have no problem with this. For example, a qualitativist might think that the fundamental qualitative facts are existentially general facts that can be expressed in predicate logic with identity but without constants, in which case the Max Black world can be described as follows:

$$(\exists x)(\exists y)(Fx \ \& \ Fy \ \& \ \sim x=y)$$

where 'F' expresses the qualities of each sphere.<sup>47</sup>

But still, even if the qualitativist can describe the fundamental facts of a Max Black world, one might justify the second premise by arguing that there is no way to ground the individualistic facts about the two spheres in those underlying qualitative facts. This is close what Adams had in mind when he wrote that

... the clearest way of proving the distinctness of two properties is usually to find a possible case in which one would be exemplified without the other. In order to establish the distinctness of thisnesses [*i. e.* individualistic properties] from all suchnesses [*i. e.* qualitative properties], therefore, one might try to exhibit possible cases in which two things would possess all the same suchnesses, but with different thisnesses.<sup>48</sup>

Label one of the spheres A and the other B. Put in terms of properties, Adams' observation is that A and B share their qualitative properties

47. Even those qualitativists such as myself, who do not wish to treat existentially general facts as fundamental, can find other qualitative facts sufficient to describe the fundamental nature of a Max Black world. I say more about this in Dasgupta (2009).

48. Adams (1979), p. 12.

and yet sphere A has the individualistic property of being identical to A while B does not. This suffices to show that the individualistic property *is distinct from* any of A's qualitative properties, which was Adams' aim. To argue that the individualistic property *is not grounded in* any of A's qualitative properties, we just add the assumption that if a property P is grounded in property Q, then necessarily anything with Q also has P.

That is the argument put in terms of properties, but since we take ground to be a relation between facts let us reconstruct it in those terms. To this end, consider the fact that A exists and the fact that B exists. In what might each of these be grounded? Putting the possibility of plural grounding aside, there must be some fact about the distribution of qualitative properties that explains A's existence, and likewise for B. But, one would argue, the qualitative facts that explain A's existence must be different from those that explain B's. After all, if one asked what explains A's existence and got an answer, and then asked what explains B's existence and got the very same answer, one would naturally want to reply 'Wait a minute, that was what explained A's existence; what then makes it the case that B exists?' Now, since both spheres have many qualitative properties, one could try saying that A's existence is explained by something's being iron and spherical, and that B's existence is explained by something's being black and hard. But this would be implausible: since A and B share all their qualitative properties, it would be a mystery why being black and hard explains B's existence but not A's. Therefore, the argument goes, nothing qualitative can plausibly be said to ground A's existence and not B's; and so A's existence has no qualitative ground. The argument is therefore slightly different than that which was run against the traditional Bundle Theory. In that case, the Bundle Theory *logically implied* that the spheres were identical, contrary to hypothesis. In this more general case there is no such implication; instead, the charge is now that there is no plausible explanation of their existence.

That is, I believe, the best defense of the second premise. How should qualitativists respond? Interestingly, they almost uniformly

grant the second premise and instead deny the first. Thus, the literature is full of qualitativists bending over backwards to show that we may plausibly deny the possibility of a Max Black world. For example, Hacking (1975) argues that a Max Black world can be re-described as a world in which there is just one sphere situated in a non-Euclidean space so tightly curved that it is 2 miles from itself. And Hawthorne (published as [O'Leary-Hawthorne, 1995]) argues that individuals can be multiply located in space, so that the Max Black world can be re-described as a Euclidean world in which a single individual A is located 2 miles from itself. There appears to be an implicit assumption, then, that to block the argument the qualitativist must deny that Max Black worlds are possible.

But if pluralism about ground is true then this assumption is false. Even if we concede the possibility of Max Black worlds, the above argument for the second premise at best shows that neither A's existence nor B's existence has a qualitative ground on its own. But if pluralism is true then it remains open that the individualistic facts in the Max Black world — including A's existence and B's existence — are plurally grounded in the world's qualitative nature even though none of them have a qualitative ground on their own, just as the structuralist states. As a result, the qualitativist may concede the possibility of Max Black worlds and yet deny that they are problematic for her view. Qualitativists should welcome this result, for there are compelling arguments based on plausible assumptions that Max Black worlds are indeed possible (for example, Adams' argument from the possibility of two spheres that are *almost* qualitatively identical). A qualitativist who denies the possibility of Max Black worlds must therefore deny those plausible assumptions, but if pluralism is true there is no need for her to do so.

Of course, this is by no means a full defense of qualitativism since there are other arguments to contend with. Still, it is an example of a case in which recognizing the possibility of plural grounding has a significant, and perhaps surprising, impact on an issue in metaphysics.

Whether other issues are similarly affected is a question I leave for another time.

## 12 Conclusion

The recent literature on ground has uniformly assumed what I call singularism, according to which the logical form of a claim of grounds is that *this* (a single fact) is grounded in *them*. I have argued that if certain assumptions about the fundamental nature of the world are granted, then it is plausible that certain collections of facts are grounded plurally in the world's underlying nature: *they* (the members of the collection) are grounded in *them* even though none of them admits of a ground of its own. Our view about the logical structure of ground should therefore allow for these hypotheses: we should think that ground is irreducibly plural. If this is right, then it is important that we ensure that our metaphysical theorizing about is not implicitly infected with singularist assumptions.<sup>49</sup>

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49. The ideas in this paper were presented to my graduate seminar at Princeton in the fall of 2009, to the Paper Tigers group at Princeton in February 2010, to the 'Because I' seminar in Berlin in August 2010, to the Albritton Society at UCLA in December 2010, and to David Chalmers' seminar on structuralism in October 2012. Thanks to the participants of those events for their valuable feedback. Thanks also to Selim Berker, Daniel Berntson, Richard Chappell, Kit Fine, Vera Flocke, John Morrison, Elliot Paul, Laurie Paul, Jonathan Schaffer, Ted Sider, Jack Spencer, Michael Strevens, Brad Weslake, Bruno Whittle, Juhani Yli-Vakkuri, and three anonymous referees for their enlightening comments on earlier drafts of this material.

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