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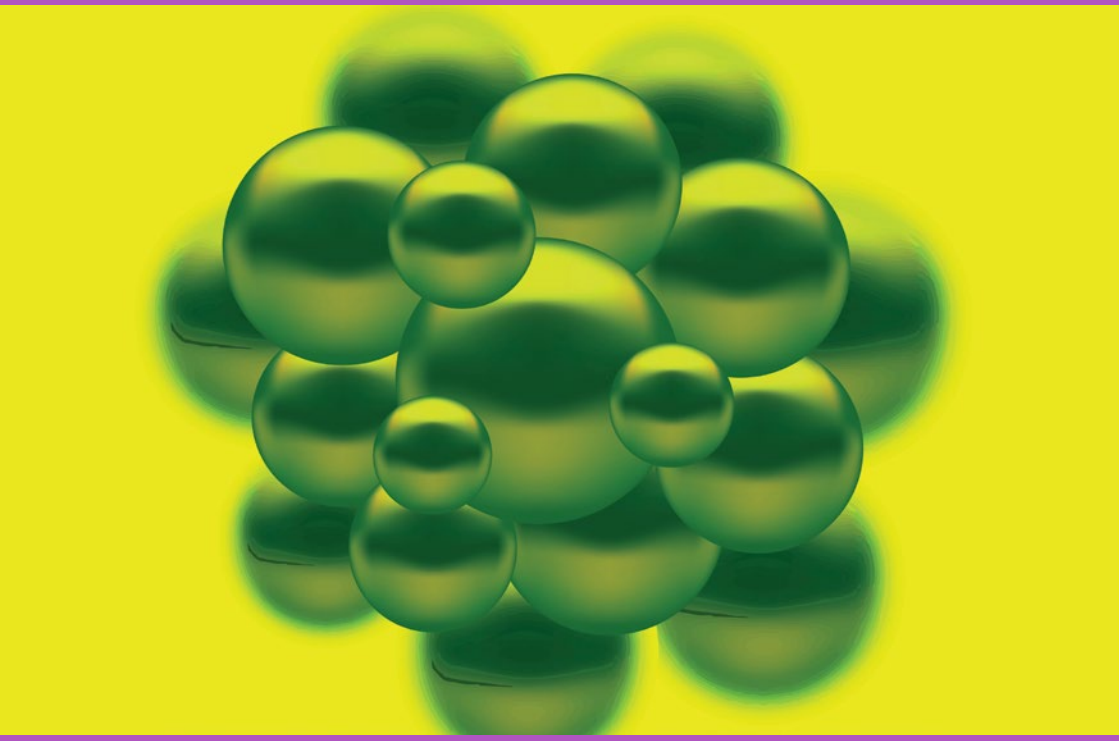

SCIENTIFIC COMPOSITION AND METAPHYSICAL GROUND

Edited by
Kenneth Aizawa and Carl Gillett

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Ground Rules: Lessons from Wilson

Jonathan Schaffer

Wilson's "No Work for a Theory of Grounding" (2014) offers an insightful critique of grounding-based approaches to metaphysical inquiry. She argues that the notion of grounding is uninformative, disunified, and in the end unhelpful. She then sketches a rival approach, which eschews the notion of grounding, in favor of a plurality of "small-'g'" grounding-type notions alongside a primitive notion of absolute fundamentality.

I think that Wilson is right to criticize many extant grounding-based approaches for not being sufficiently informative. I just think that it is possible for the grounding theorist to do better, and that my own (forthcoming) treatment in terms of structural equations (which are formal models developed for understanding causal structure) does better in the needed ways. I also think that her rival approach deserves serious consideration in its own right. But I argue that her approach is open to serious criticisms, including every one of the criticisms she levels at the grounding theorist.

J. Schaffer (✉)
Rutgers University, New Brunswick, NJ, USA

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K. Aizawa, C. Gillett (eds.), *Scientific Composition and Metaphysical Ground*, DOI 10.1057/978-1-137-56216-6_6

My subtitle is "Lessons from Wilson" since I am saying that all theorists—including Wilson herself—should draw the lesson that one needs more informative conceptions of metaphysical structure, of the sort I take structural equation models to provide.

My main title is "Ground Rules," which I offer as a three-way pun. First, one of the underlying issues between Wilson and myself is whether the notion of grounding is sufficiently unified for useful work. Such issues of unity arise not just with the notion of grounding, but with virtually all interesting philosophical concepts. So I want to articulate some general *ground rules* for unity debates. Second, I want to discuss a formalism to model grounding, which will display the *rules of grounding*. These first two ideas are related, insofar as I think that the general way to adjudicate unity debates is by looking at the best formalism, and seeing whether or not it enfolds the notion in a unified set of rules. Third, I want to express my continued enthusiasm for the notion of grounding as one that can be framed in a unified, informative, and helpful way, and so I exclaim: *ground rules!*

Overview: In section "A Brief Introduction to Grounding", I offer a brief introduction to the notion of grounding. In sections "Are Grounding Claims Informative? and Are Grounding Claims Helpful?", I take up Wilson's two main objections to grounding-based approaches—that bare grounding claims are uninformative, and that such claims are unhelpful—and extract two main lessons. In section "Wilson's Pluralistic Framework", I critique Wilson's rival pluralistic approach for, among other things, not taking up Wilson's own lessons. I conclude in section "Structural Equation Models to the Rescue" by explaining how an approach based on structural equation models for grounding has a special claim to adequacy.

A Brief Introduction to Grounding

Grounding has been championed by philosophers including Fine (2001), Correia (2005), Schaffer (2009), Rosen (2010), and Bennett (2011). We do not agree on all details, and accordingly I only claim to speak for myself. Grounding—as I understand it—connects more to less funda-

mental entities and thereby imposes structure over what there is. Some entities are more fundamental than others (for instance, particles are more fundamental than chemicals, and chemicals are more fundamental than animals). Once one distinguishes more from less fundamental entities, it is natural to posit *a relation linking certain more fundamental entities to certain less fundamental entities which derive from them*. Grounding names this directed linkage.

Grounding may be understood as the relation of dependence which philosophers tried but failed to understand via the modal pattern of *supervenience*. As Kim (1993: 167) notes:

> Supervenience itself is not an explanatory relation. It is not a "deep" metaphysical relation; rather, it is a "surface" relation that reports a pattern of property covariation, suggesting the presence of an interesting dependency relation that might explain it.

Supervenience, after all, is a reflexive and (*a fortiori*) non-asymmetric relation, as well as a merely intensional relation that cannot distinguish features of reality found at all the same possibilities. So grounding may be understood as the "deep" relation of dependence which "shallow" supervenience analyses unsuccessfully targeted. In my view, one of the morals of the failure of the supervenience analysis is that the notion of metaphysical dependence is needed but unanalyzable, and hence best treated as primitive.[1]

Grounding then serves to back a distinctive sort of *metaphysical explanation*. If one wants to understand, for instance, why there is an H_2O molecule present, then one perfectly good sort of explanation for this fact would involve the fact that an H, another H, and an O atom are arranged and bonded in the right way. This is not a diachronic causal explanation, citing previous causes. (A diachronic causal explanation might for instance cite the previous events in which hydrogen and oxygen gasses were combined and exposed to a spark.) It is rather a synchronic metaphysical explanation, citing the more fundamental basis at the time. Just as causation provides the direction and the linkage needed for causal

[1] Of course I cannot prove the negative existential that there is no reductive analysis of the concept of grounding to be found (though when has reductive conceptual analysis ever succeeded?); I only mean to say that it is legitimate to use the concept regardless, without any such analysis to hand.

explanation, so grounding provides the direction and the linkage needed for metaphysical explanation. The reason why there is an explanatory link from the presence and arrangement of the H, H, and O to the presence of the H_2O is that the H, H, and O ground the H_2O. In this vein, Audi (2012: 104) says, "The reason we must countenance grounding is that it is indispensable to certain important explanations."[2]

Many of the most interesting debates in metaphysics can then be understood as debates about what grounds what (and consequently which facts explain which). For instance, disputants in the metaphysics of mind usually agree that the physical and the mental both exist. They disagree as to whether the physical grounds the mental (as the physicalist/materialist thinks), or whether the mental grounds the physical (as the idealist thinks), or whether both are independently fundamental aspects of reality (as the dualist thinks).

I cannot offer a more detailed motivation for invoking such a notion of grounding here (see Schaffer 2009; forthcoming), though this brief sketch should be sufficient for the discussion to come. For Wilson thinks that this entire picture—alluring as it may seem—is superficial and in the end worthless, and she says that she can paint a better picture.

Are Grounding Claims Informative?

Wilson, on my reading, makes three main points, the first of which is that *bare grounding claims*—claims of the form "*this* grounds *that*"—are uninformative. Thus, she (2014: 546) considers the metaphysician—let us name her Natalie—who says that the natural grounds the normative, and points out just how much is left open:

> [N]aturalists do not care only about whether, for example, normative goings-on metaphysically depend on naturalistic goings-on: they also care

[2] According to Salmon (1984), the lesson to be drawn from the failure of deductive-nomological accounts of explanation is that explanation must be backed by *causation*, to make sense of the connections behind and the ordering of explanation. For metaphysical explanation then one also needs a connecting and ordering relation, running not from cause to effect but from more basic to less basic. This is grounding.

> about whether normative goings-on exist; about whether, if they exist, they are reducible or rather irreducible to (though still nothing over and above) naturalistic goings-on; about how exactly normative goings-on are related to naturalistic goings-on; about whether normative goings-on are efficacious and, if so, whether they are distinctively efficacious (that is, efficacious qua normative); and so on. Hence it is that naturalists almost never rest with the schematically expressed locutions of metaphysical dependence, but rather go on to stake out different positions concerning how, exactly, the normative or other goings-on metaphysically depend on the naturalistic ones.

So Wilson (2014: 545) thinks that our friend Natalie has managed to tell us "almost nothing about how, exactly, normative and intentional goings-on stand to naturalistic goings-on."

I think that there is something right and insightful here, but that it is hard to identify exactly what. Or at least, I found Wilson's objection initially puzzling. For imagine a scientist—let us name him Sigmund—who utters a bare causal claim, such as "smoking causes cancer." Wilson's main concerns about Natalie could equally be raised about our new friend Sigmund. After all—to mimic what Wilson says—scientists do not only care about whether smoking causes cancer; they also care about whether cancer exists, about how exactly smoking is related to cancer, and about what the more fundamental physicochemical conditions underlying cancer are, and so on. So what? Surely—whatever the ultimate status of causation may be—these observations alone do not show that the notion of causation is uninformative and unhelpful! So how could Wilson's concerns possibly show that the notion of grounding is uninformative and unhelpful?

Clearly, both Sigmund and Natalie have told us something *informative*. Sigmund has said something that rules out alternatives such as that smoking is causally unrelated to cancer, or only related as a correlate of a common cause (indeed decades of careful medical research, countered by costly corporate propaganda, went into establishing his claim). Likewise Natalie has said something that rules out alternatives such as those given by certain forms of moral realism and by divine command theory (centuries of philosophical debate have centered on assessing her claim).

Both Sigmund and Natalie have also told us something *helpful*, insofar as causation and grounding both serve to provide explanatory handles on the world. Sigmund has said something that might help us understand, for example, why a particular smoker has cancer, and likewise Natalie has said something that might help us understand, for example, why a particular natural situation is morally impermissible.

Of course neither Sigmund nor Natalie has said *everything*, but so what? Given anything short of a maximally specific description of reality, there will always be more information to add. What is the problem with informative and helpful claims that merely leave some further questions open? So when Wilson says that Natalie has said "almost nothing," I want to ask back, *do you mean that Natalie has said nothing, or that she has said something but should just say more?* The former option strikes me as false and the latter true but unobjectionable.[3]

Of course if Sigmund refuses to say anything further about the smoking–cancer connection beyond "smoking causes cancer," then something has gone wrong. But the problem here is not with bare causal claims, nor with the concept of causation they involve, but only with the strangely silent theorist who refuses to do anything more than make such bare causal claims. Likewise if Natalie should refuse to say anything further about the natural–normative connection, then something has gone wrong. Wilson (2014: 549) speaks of "the perversely uninterested metaphysician" who only makes bare grounding claims and says nothing further. But the problem here is likewise not with bare grounding claims, nor with the concept of grounding they involve, but only with the "perversely

[3] *Two puzzling passages*: Wilson (2014: 544–5) says that it "is not just that Grounding (failure of Grounding) claims leave some interesting questions open; rather, it is that such claims leave open questions that *must be answered* to gain even basic illumination about or allow even basic assessment of claims of metaphysical dependence, or associated theses such as naturalism." But I find this puzzling since she does not say what she means by distinguishing merely "interesting questions" from those that "must be answered," or relatedly what she means by "basic illumination." And I think she is just wrong that bare grounding claims cannot be assessed. Natalie's claim, for instance, rules out alternatives such as divine command theory. So if divine command theory could be shown to be true, Natalie's claim would thereby be shown to be false.

Wilson (2014: 553; also 575) also takes up the analogy with bare causal claims. She allows that bare causal claims are informative for entailing that their relata exist as distinct and causally connected events, but admits no comparable value to bare grounding claims. But I find this puzzling as well since, at least by my lights, grounding claims are informationally comparable: they entail that their relata exist as non-distinct and grounding-connected entities.

uninterested" theorist who refuses to do anything more than make such bare grounding claims. One need only ask both Sigmund and Natalie to say more.

What more should they say? It is worth distinguishing three respects in which both Sigmund and Natalie should say more, which arise from separating three of the follow-up questions Wilson poses: (1) "whether normative goings-on exist," (2) "whether normative goings-on are efficacious," and (3) "how exactly normative goings-on are related to naturalistic goings-on." As to questions such as (1) "whether normative goings-on exist," I think that this is a matter of settling *conceptual entailments.* I say that both causation and grounding entail the existence of their relata, so that an adequate conception of causation must have it that "Yul Brynner's smoking caused his lung cancer" entails the existence of Brynner's smoking and his lung cancer, and that an adequate account of grounding must have it that "Marquis de Sade's inflicting pain grounds his acting wrongly" entails the existence of de Sade's inflicting pain and his acting wrongly.[4] So—assuming that Sigmund thinks that there are episodes of smoking causing cancer—I say that he is thereby implicitly committed to saying that cancer exists. And likewise—assuming that Natalie thinks that there are episodes of the natural grounding the normative—I say that she is thereby implicitly committed to saying that the normative exists.

As to questions such as (2) "whether normative goings-on are efficacious," I think that this is a matter of recognizing *conceptual separations.* I say that grounding is neutral as to the causal efficacy of its relata, so that an adequate account of grounding may allow "Marquis de Sade's inflicting pain grounds his acting wrongly" to be consistent with *both* the idea that de Sade's acting wrongly is causally efficacious, *and* the idea that de Sade's acting wrongly is causally inert. So I say that Natalie has so far remained non-committal on the causal efficacy of the normative. One can make informative and helpful claims while still leaving other questions open.

[4] I have switched from generics ("smoking causes cancer," "pain grounds wrongness") to episodics, since at least some types of generics can hold without episodes ("this machine crushes oranges" can be true even if it never gets turned on). This matter has nothing to do with causation or grounding, but purely with the semantics of generic constructions.

As to (3) "how exactly normative goings-on are related to naturalistic goings-on," I think that this is the most interesting follow-up question, insofar as it is a matter of appreciating *conceptual embeddings*. When Sigmund says that smoking causes cancer, there are several further *causal "how" questions* he should try to say more about, where the right answer is neither entailed by nor separated from the causal connection between smoking and cancer. One sort of causal "how" question looming concerns the causal mechanisms involved which mediate the link. (Is it the nicotine, the tar, or perhaps the smoke and associated inflammatory reaction in the body?) These questions can be resolved by further bare causal claims concerning candidate intermediaries. (Does nicotine cause cancer? Does tar cause cancer? Can repeated inflammatory reactions in the body cause cancer?)

But a second and distinct sort of causal "how" question looming concerns the shape of the association between any given cause and effect. (Is cancer risk linear with cigarettes per day, or does the risk peak at two cigarettes per day and level off or even decline thereafter, or … ?) These latter questions are the more interesting questions, insofar as they push one to embed causal claims in a deeper framework that posits not just an on–off connection (cause or no cause?) but a more informative function relating a range of values for the cause option (number of cigarettes per day) to a range of values for the effect option (risk of cancer).

Likewise when Natalie says that the natural grounds the normative, I think (section "Structural Equation Models to the Rescue") that one should ask her to embed her grounding claim in a deeper framework that posits not just an on–off connection (ground or no ground?) but a function relating a range of values for the more basic option (different states of nature, such as those differing in the pleasure-to-pain ratio) to a range of values for the derivative option (different normative statuses, such as position in the preferability rank). The grounding framework would then include information "about how exactly normative goings-on are related to naturalistic goings-on." Ideally, one should want to know the precise rule taking certain aspects of the natural state of the situation as input, and delivering the normative status of the situation as output.[5]

[5] *Caveat*: Wilson herself may be understanding her own "how exactly" question in a weaker way, since she (2014: 546–7) only asks the grounding theories to choose between options such as the following:

So I agree with Wilson that Natalie's bare grounding claim leaves open how the grounding pattern works, and think that there is an important lesson to be drawn from this. But I think that the lesson is not to discard the notion of grounding but to develop it further, in ways that allow one to go beyond bare grounding claims and add even more information about the underlying pattern. Thus, I think that Wilson is best understood as offering the following lesson:

> *Wilson's first lesson*: An account of grounding must give one more than just the bare ideology of "this grounds that"; it must also allow one to make sense of follow-up inquiry into *how* the connection runs, in terms of the specific rule mapping the more basic inputs to the less basic output.

Are Grounding Claims Helpful?

Wilson's second main point, following on her first point that bare grounding claims are not sufficiently informative, is that the metaphysician will inevitably be driven to say more, and in particular will be driven to speak of more specific "small-'g'" grounding-type relations in explaining how the grounding connection works. Thus, she (2014: 540) says:

> Grounding, like supervenience, is too coarse-grained to do the work of appropriately characterizing metaphysical dependence on its own, failing to distinguish importantly different (eliminativist, reductionist, non-reductionist, emergentist) accounts of such dependence, … Investigations into metaphysical dependence cannot avoid appealing to the specific "small-'g'" grounding

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> [A] naturalist might be a "role functionalist", maintaining that normative state types are characterized by functional or causal roles played by naturalistic state types. Or a naturalist might maintain that normative state types and/or tokens stand in something like the determinable/determinate relation to naturalistic goings-on. Or a naturalist might maintain that normative state types and/or tokens are appropriately seen as proper parts of naturalistic state types and/or tokens.

Now when one specifies a function, one may specify the function *in extension* as a list of ordered pairs, or specify it *in intension* as a rule which maps input to output. I think of Wilson's options as coarse-grained types of rules, and am saying that one should ultimately want the specific rule involved.

> relations… that are capable of answering these crucially basic questions about the existential, ontological, metaphysical, and causal status of metaphysically dependent goings-on.

Among the "small-'g'" grounding relations, she (2014: 535) includes "type and token identity, functional realization, the classical mereological parthood relation, the causal composition relation, the set membership relation, the proper subset relation, the determinable/determinate relation, and so on." But—she adds (2014: 553; also 576)—once the "small-'g'" grounding relation is specified (as it must be), the need to speak generically of grounding is lost: "But insofar as appeal to specific 'small-g' grounding relations is required to gain even basic illumination about metaphysical dependence, what if any point is there moreover to positing Grounding?" And so she says that the notion of grounding is unhelpful, because it is inevitably superseded.[6]

I agree with Wilson that the metaphysician will be driven to make sense of how the grounding connection works in these sorts of ways. (I do not fully agree with Wilson's list of species of grounding relations—for instance, I would not include identity as a grounding relation—but the matter is not directly relevant here.) Indeed I think that the metaphysician will be driven to take the matter still further, and try to articulate the specific rule linking the more fundamental input to the less fundamental output. That is essentially *Wilson's first lesson*. But I do not see how it follows from the fact that one may be driven to decide which species of a given genus is found, and that the genus notion is thereby unhelpful and to-be-discarded. (Otherwise one is headed toward a radical elimination of every genus notion!) Again I think that there is something right and insightful here, but that it takes some work to identify exactly what.

Return again to the guiding case of causation. Most would agree that there are species of causal relations. But from the fact that one may be

[6] Here I am simplifying Wilson's argument considerably. As I read her, the "grounding is inevitably superseded" claim comes on p. 553, and much of the rest of her paper rebuts various reasons one might give for saying that grounding is still worth positing. In Wilson's terms, I am probably best classified as defending what she (2014: 567) calls the "general unifier of the specific grounding relations" rationale, though—as comes out in section "Wilson's Pluralistic Framework"—I also endorse what she (2014: 558) calls the "fix the direction of priority" rationale. (My thanks to Jessica Wilson for helpful clarifications.)

driven to decide the detailed sorts of causal connections involved in the (quite complicated) relationship between smoking and cancer, it does not follow that it is unhelpful to have the notion of causation, or to use it in saying that smoking causes cancer. (I am not assuming that there is a unified genus notion of causation worth positing. I think that there is such a unified genus, but that is a substantive claim to be argued for. I am only saying that it does not follow that there is no unified genus of causation, simply from the truism that one may be driven to further specify the type of "small-'c'" causal relation involved in a given case.)

There is a very general issue looming, which arises for virtually all philosophically interesting concepts, which is when there is a unified notion worth positing. For virtually any candidate notion, there will be *monists* who think that there is a single unified concept to be posited, surrounded on the one side by *nihilists* who deny that there is even one meaningful concept being invoked, and on the other side by *pluralists* who say that there are many distinct concepts being conflated.[7] Indeed every philosopher will deploy some concepts in a monistic spirit, dismiss other concepts in a nihilistic spirit, and divide other concepts in a pluralistic spirit. So everyone should be interested in *principled* ways of deciding when to be a monist, a nihilist, or a pluralist, for any given target concept.

It seems to me that the best principled way to decide when to be a monist, a nihilist, or a pluralist for a given concept is to construct the best formalism one can for the concept. If there is no meaningful concept, this should show up in a lack of any clear formalism, and if there are many, this should show up in a need for a formal distinction. But if one winds up with a clear and precise formalism that embeds the concept in a unified way, then this is a good sign that there is a single unified concept. I offer this as a general "ground rule" for unity debates: *let the best formalism decide* (Rosen 2010: 114; Schaffer forthcoming, Sect. 4.4).[8]

[7] In the grounding literature, Fine, Rosen, and I are paradigm monists (though Fine is hard to classify since he also distinguishes metaphysical, natural, and normative ground), Hofweber (2009) and Daly (2012) are nihilists, and Wilson (2014) and Koslicki (2015) are pluralists. In the causation literature, monism has been the dominant view, but the early Russell (1912; though not 1948) is a nihilist, and Anscombe (1975), Cartwright (2007), and Hall (2004) are pluralists.

[8] Some may wish to add the requirement that there is a single guiding idea behind the formalism. For instance, there is an ongoing debate about set theory, as to the extent to which the Zermelo-Fraenkel axioms (ZFC) can be seen as guided by the iterative conception of sets (cf. Boolos 1971).

To illustrate, consider causation yet again. What would constitute a decent test for causal monism? I offer this: develop a formalism for causation, and see whether nothing clear and informative emerges (a sign of nihilism), or whether one must distinguish "red" arrows for one type of causal connection from "blue" arrows for another type of causal connection (a sign of pluralism), or whether one can in the end succeed in saying something clear and informative using only a single colored arrow (a sign of monism).

This ground rule is intended as a decent rule of thumb, and neither as a mechanical nor as an infallible procedure. There can be dispute over what the best formalism is, there can be questions about when a formalism is embedding a concept in a unified way, and it is at least conceivable that our best formalism could attribute more or less unity to a given concept than is really present.[9] I just think that in the cases at hand—namely the cases of causation and grounding—the best formalism for both makes use of structural equation models, and clearly does not need to draw different colored arrows for different flavors of dependence (section "Structural Equation Models to the Rescue"). If so, then *the notion of grounding has exactly the same claim to unity as the notion of causation*.

With this ground rule in mind, I return to the question of why the notions of grounding and causation—and genus notions generally—may still be helpful, even if there is always a possible follow-up question as to which species is found. I offer two answers, my first of which is that without the genus notion, one may *miss relevant generalizations*. These generalizations are part of what the best formalism for the notion must capture. The best formalism should include rules involving the notion, which encode the generalizations one would lose without the notion.

For instance, assuming that Brynner's smoking 100 cigarettes per day caused his lung cancer, one should want a framework for causation that

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The structural equations model approach I advocate (section "Structural Equation Models to the Rescue") comes out very well on this score, as it has a strong claim to be guided by the idea of directed dependency. (My thanks to Jon Litland on this point.)

[9] Wilson (2014: 568) offers determinable properties as a potential case where the formalism attributes more unity than "philosophers commonly assume." But first, Wilson herself thinks that this is the wrong view of determinables (cf. Wilson 2012). Second, I do not think it is clear what the best formalism for determinate–determinable structure is. (I would be content to let the best formalism decide in this case as well.) Third, I do not claim the test to be perfect anyway, but just a decent guide. I do not know if Wilson would contest this more modest claim.

allows us to infer Brynner's cancer risk given that he smoked 100 cigarettes per day, to counterfactually consider what Brynner's cancer risk would have been had he smoked 0 cigarettes per day (or 20, or 200), and to underwrite explanatory claims as to why Brynner developed lung cancer. Such a framework would display the relevant connections between causation, inference, counterfactuals, and explanation, which constitute some of the generalizations that make causation worth positing. Likewise, assuming that de Sade's acting to inflict pain grounds his acting wrongly, one should want a framework for grounding that allows us to infer the wrongness of de Sade's action given that he acted to inflict pain, to counterfactually consider the normative status of alternative courses of action, and to underwrite explanatory claims as to why de Sade has acted wrongly.

My second answer as to why genus notions may still be helpful is that without the genus notion one may be unable to *enumerate the species*. For instance, a theorist who refused the general notion of causation would have no clear way to enumerate her own "small-'c'" causal relations. To illustrate, let us imagine that she starts off by invoking some more specific causative notions like "baking, making, waking…" How can she continue? She cannot say "…and all other species of causation" because that would be cheating (explicitly invoking the very notion of causation that she has foresworn). And she cannot just say "…and so on" because what could that mean for her (besides serving as a device to implicitly invoke the very concept of causation that she has foresworn)? Likewise, the theorist who refused the general notion of grounding would have no clear way to enumerate her own preferred menu of "small-'g'" grounding relations. Wilson herself (2014: 535) resorts to "and so on" when listing her own open-ended plurality of "small-'g'" grounding relations, and so one must wonder how she understands her own list to continue, if not in terms of listing further species of the very genus notion that she has foresworn, namely *grounding*.

So I think that what is right and insightful in Wilson's complaint is that *the best way to determine whether a genus notion is helpful is to embed the notion in a formalism which treats the notion in a unified way, and reveals the generalizations one would miss without the notion*. For without such an embedding, one has no rules governing the notion. Accordingly, I think that Wilson is best understood as offering the following further lesson:

Wilson's second lesson: An account of grounding should be embedded in a formalism that outfits the notion with unified rules and so reveals useful generalizations one would miss without the notion.

Wilson's Pluralistic Framework

Having argued that bare grounding claims are not sufficiently informative, and that the metaphysician will inevitably be driven to speak of more specific "small-'g'" grounding relations in explaining how the grounding connection works, Wilson then—third—sketches an alternative pluralist framework that eschews the general notion of grounding and only uses the more specific "small-'g'" concepts. She (2014: 576) endorses the interest in questions of what grounds what (cf. Schaffer 2009):

> Proponents of Grounding are correct that metaphysicians should be concerned with the question of what metaphysically depends on what; and they are correct that the idioms of metaphysical dependence are not properly interpreted in semantic, epistemic, causal or merely modal terms.

But she (2014: 576) claims that the notion of dependence is best understood as "schematic," merely standing in for some yet-to-be-specified one of her many "small-'g'" grounding relations:

> [S]uch idioms should rather be taken just to advert, schematically or otherwise, to one or other of the specific metaphysical relations—type and token identity, the functional realization relation, the classical mereological part-whole relation, the causal composition relation, the set membership relation, the proper subset relation, the determinable–determinate relation, etc.—already on the scene.

So far it might seem as if Wilson was not positing anything metaphysically new, but on the contrary advocating that the "new questions" of dependence should be interpreted schematically against the backdrop of a plurality of "old relations."

Not so: there is a twist. For Wilson (2014: 558–62) considers an argument for grounding—which she credits to Fine and Hellie, and labels the

"fix the direction of priority" argument—that grounding is needed to make sense of questions as to which end of one of her "small-'g'" relations is the more fundamental end. For instance, even given that this particle is a part of the cosmos, there is a remaining question as to whether the whole depends on the part or the part on the whole (see generally Schaffer 2010). Wilson acknowledges the force of the objection and thus sees fit to posit her own distinctive hyperintensional primitive structuring concept of metaphysical inquiry, that of (absolute) *fundamentality*. So she (2014: 561) says:

> Which entities are in the fundamental base is primitive; this primitive specification then fixes the direction of priority (assuming there is one, as there may not be in cases of self- or mutual grounding, or cases of entities having nothing to do with one another) associated with a given specific "small-g" grounding relation, when applied to goings-on in the base; effectively, fundamentality is hyperintensional. For example, if the One is primitively fundamental, then proper parts of the One will be non-fundamental; if the Many are primitively fundamental, then fusions of the Many will be non-fundamental.

So Wilson also posits her own primitive structuring concept of metaphysical inquiry, to help orient her plurality of "small-'g'" grounding relations in the right direction.

I pause to note how—rhetoric aside—Wilson winds up largely agreeing with friends of grounding. The underlying point of agreement is that the metaphysician needs a new primitive hyperintensional notion to go beyond merely listing what exists so as to characterize the structure of reality. The main residual disagreement is whether this primitive should be one of *being-absolutely-fundamental,* or the relative and linking notion of *grounding* (/*being-relatively-more-fundamental-than-and-linked-to*). These notions are respectively analogous to *being-causally-initial* and *causing* (*being-relatively-causally-earlier-than-and-linked-to*).[10] This is not to say that there is no disagreement between Wilson and friends of grounding

[10] Both grounding and causation are notions of a directed linkage, which is why they are both apt to back explanation (section "A Brief Introduction to Grounding"). Note that the "*and-linked-too*" bit is needed. This H atom on Earth is relatively more fundamental than that H_2O molecule on Mars just because atoms are generally more fundamental than molecules, even though this atom is not linked to that molecule (cf. Bennett forthcoming: Chap. 5). Likewise this event on Earth yesterday is relatively causally earlier than that event on Mars today just because of the overall causal–

such as myself (cf. Wilson 2014: 562–3), but only that there is a merely internecine disagreement between those friends of primitive hyperintensional notions of metaphysical structure such as Rosen and I who opt to take grounding as primitive, those friends such as Wilson (also Sider 2011) who prefer to take being-absolutely-fundamental as primitive, and those such as Fine who claim a need for multiple primitive notions in the neighborhood.

That said—degree of real disagreement aside—I think that Wilson's framework is clearly worthy of serious consideration. I have three objections, however, the first of which is that I think Wilson's framework is impoverished compared to the grounding framework. It seems to me that absolute fundamentality can easily be defined in terms of grounding (the fundamental is that which has no deeper grounds), and so a framework using grounding as a primitive can easily be used to say everything one wants to say via absolute fundamentality. But there is no obvious definition to be found in the other direction, and so it is not at all obvious that using absolute fundamentality as a primitive will allow one to say everything one wants to say in terms of relative fundamentality, or in the even stronger linking terms of the grounding connection.

This impoverishment makes trouble for Wilson in scenarios in which there is no fundamental level at all, but just a limitless descent of ever-deeper structure. If such a scenario is metaphysically possible,[11] it is trouble for Wilson, for her framework can attribute no metaphysical structure to it. After all, when nothing is metaphysically fundamental, her primitive gives no guidance. But the friend of relative fundamentality can still make sense of metaphysical structure in such scenarios, including the guiding idea that things are getting ever more fundamental without limit.

This relative impoverishment also makes trouble for Wilson, with respect to making sense of structure among non-fundamental entities.

temporal order, even though these two events are not linked. (My thanks to Ross Cameron for insightful comments which prompted these clarifications.)

[11] I myself have wavered over whether such a scenario is metaphysically possible. If parts are always more fundamental than wholes, and if "gunky" structures with limitless descending chains of parthood are possible, then one seems to get scenarios with no fundamental entities at all (Schaffer 2003). But if one does not assume that parts are always more fundamental than wholes, then no such argument looms, and one may be able to respect the intuition that there needs to be an ultimate ground of being (Schaffer 2010: Sect. 2.4).

Suppose that what is fundamental are just particles in the void, and consider the following three non-fundamental entities: my whole body, my whole body minus my left shoulder, and my heart. Holding fixed that particles in the void are fundamental, and holding fixed the mereological and other "small-'g'" relations among these three entities, there still seems to be a residual question as to the direction of fundamentality (and one not so different in spirit from the question of whether the ultimate parts or the ultimate whole is basic, which inspired Wilson to add a primitive notion of fundamentality in the first place). Again Wilson's view seems to give no guidance.[12] So overall I do not think that Wilson has successfully blocked the "fix the direction of priority" argument for grounding.

My second and third objections concern whether Wilson's own framework is equally liable to the criticisms she herself levels against grounding theorists. It seems to me that Wilson's own framework does not adequately take up her own lessons, which (to repeat) were:

> *Wilson's first lesson*: An account of grounding must give one more than just the bare ideology of "this grounds that;" it must also allow one to make sense of follow-up inquiry into *how* the connection runs, in terms of the specific rule mapping the more basic inputs to the less basic output.
>
> *Wilson's second lesson*: An account of grounding should be embedded in a formalism that outfits the notion with unified rules and so reveals useful generalizations one would miss without the notion.

As to *Wilson's first lesson*, while she goes beyond the bare ideology of "this grounds that," she also stops short of saying exactly how the grounding connection works, and instead settles for some in-between resting point involving her "small-'g'" relations. So by Wilson's lights, if Natalie just says that the natural grounds the normative, then what she has said

[12] Wilson herself (2014: 564–6) takes up a similar example, but I am afraid that I do not understand her reply. I read her as saying that the answer turns on whether one treats the entities involved as fusions or as functionally defined entities. But I do not see how either treatment makes a difference within Wilson's framework, unless one also has some general principle of relative fundamentality for fusions or for functionally defined entities (etc.) For suppose that my whole body, my whole body minus my left shoulder, and my heart are all understood as fusions, and that particles are fundamental. I see no way to extract any conclusion as to relative fundamentality for these fusions, without some general principle connecting parthood to relative fundamentality.

is uninformative and unhelpful, "perversely uninterested," and not even giving "basic information," partly for failing to specify how the grounding connection works. But if a rival metaphysician—let us name him Patrick—just adds (as per Wilson 2014: 547) that normative state tokens are proper parts of natural state tokens, then by Wilson's lights Patrick has suddenly said something informative and helpful. I find this baffling. That is, I find it baffling to think that there is such a vast gap between what Natalie started with and what Patrick added. By my lights, both have said informative and potentially helpful things, though both should say more about how exactly the connection works, and they should do so by staring the connecting rule as precisely as possible.

The guiding analogy with causation is again helpful. Imagine that a rival scientist—let us name her Renata—starts with Sigmund's bare causal claim that smoking causes cancer, and adds some information about the species of "small-'c'" causal relation involved. Perhaps Renata has a specific causative notion of "inflaming" or perhaps she only has the specific causative notions of "production" and "dependence" (cf. Hall 2004). So perhaps she says that smoking inflames cancer, or perhaps she says that smoking produces cancer. If someone were to say that Sigmund's original claim was uninformative and unhelpful, but that Renata's addition suddenly crosses over to the informative and helpful, I would be baffled. With causation, what one needs in the end is not to move to more specific causatives (though sometimes that can be a helpful step), but to specify the underlying pattern of association as precisely as possible, which Renata has not yet done.

Wilson herself (2014: 548) asks rhetorically: "[S]hould metaphysicians resist being as articulate as their metaphysical means allow in characterizing what depends on what?" Insofar as Wilson's view settles for some in-between resting point involving her "small-'g'" relations, without specifying the exact connecting rule involved, it seems to me that she has not heeded her own wise advice.

As to *Wilson's second lesson*, while she is a pluralist about the concept of grounding and dismisses it as disunified, she deploys her own preferred concepts—including both her primitive notion of fundamentality, and her various posited "small-'g'" relations such as identity, parthood, and causal composition—in a monistic spirit. Wilson does not offer general criteria for when a given concept is unified, nor does she give any defense of the unity

of her preferred concepts. So I cannot guess why she thinks that her preferred concepts are any better off than grounding. But it seems to me that every concern she raises against grounding being too uninformative and needing to be superseded by more specific relations could have been raised with equal force against virtually every notion that she herself deploys.

Consider Wilson's primitive posit of fundamentality. Could the metaphysician rest with bare claims of the form "this is fundamental" (/"this is not fundamental")? Of course not. With the posit of fundamentality will come the need to settle certain framework questions (e.g., does fundamentality entail existence?), and to integrate the machinery of fundamentality into the machinery of Wilson's "small-'g'" relations (e.g., Can entities related by proper parthood both be fundamental? Can entities related by set formation both be fundamental?) And—perhaps most relevantly given the current dialectic—there will be the question (one which Wilson especially should face) as to whether there is a single unifed notion of fundamentality, as opposed to a merely schematic notion standing in for some yet-to-be-specified "small-'f'" status, such as *being mereologically atomic* and *being set theoretically elemental*.

Or consider causation, as involved in Wilson's own notion of causal composition. As I have argued throughout the preceding discussion, parallel issues of unity arise for both grounding and causation. Overall I find it puzzling that Wilson dismisses the notion of grounding as disunified, but then goes on to deploy notions such as fundamentality and causation with no concern as to their unity. At minimum, she owes a reason for thinking that her preferred notions are any better off.

So I conclude that Wilson's interesting and original view is not just impoverished but also fails to heed her main lessons. Wilson's framework does not succeed in saying how exactly the grounding connection works (at most it says something slightly more specific, using some intermediate determinables instead of specifying precise rules), and Wilson's framework is not associated with any formalism by which the unity of concepts is judged in a principled way (I see no stable general conception of conceptual unity behind it, nor any reason to regard Wilson's preferred notions such as fundamentality and causal composition as being any better off). I conclude that Wilson's alternative view is a step in the wrong direction, even by her own lights.

Structural Equation Models to the Rescue

So far I have extracted two lessons from Wilson's insightful critique of grounding, and argued that Wilson's own alternative view is not just impoverished but also fails to heed her own main lessons. Can one do better?

I should first acknowledge that I think that previous accounts of grounding—including my own—also fail to heed Wilson's lessons, and in that respect her critique is successful. In earlier work (Schaffer 2009), I basically spoke of a binary "*this* grounds *that*" relation, to which I attributed little structure beyond that of inducing a partial ordering. I included nothing that made sense of follow-up inquiry into *how* the grounding connection works, and did virtually nothing to embed grounding into a formalism that displays its informative general structural features. (Lessons learned!)

I equally think that Fine's and Rosen's accounts (Wilson's other main targets) fall afoul of her lessons. Both work with a simple on/off grounding connection, without any natural connection to follow-up "how" questions. Both do more to embed grounding into a formalism (indeed Fine 2012 presents an exquisitely developed logic for grounding), but still do not connect grounding to the most important surrounding notions of inference, counterfactuals, and explanation.[13]

Yet in the case of causation, the technology already exists to go further and say how exactly the causal pattern works, and to connect causation to inference, counterfactuals, and explanation, via structural equation models (see generally Pearl 2000; Spirtes et al. 2000). Structural equation models are systems of mathematical representation developed for understanding causal structure, but they readily extend beyond causal structure to any directed dependency structure. There is nothing specifically causal in the math. (*The big picture*: Explanation is about tracking real dependencies (cf. Kim 1994), causation and grounding are both spe-

[13] Indeed my main criticism of these views (Schaffer forthcoming: Sects. 4.1–4.3) is that they conflate grounding with metaphysical explanation, which is tantamount to conflating causation with causal explanation.

cies of dependence, and structural equations are our best technology for modeling dependence.)

In what remains, I briefly sketch the structural equation models I now favor for understanding grounding (Schaffer forthcoming), and explain how this approach fully respects Wilson's lessons (in a way already known to work quite well for causation) and thereby has a special claim to adequacy. I am *not* saying that such models are perfect or that there is no further work to be done. I am *only* saying that the technology already exists to provide a fairly informative conception of grounding, and so absorb Wilson's lessons.[14]

It is useful to think of a structural equation model as constructed in three stages (Halpern 2000). First, one is trying to model some portion of reality, so one sets up some variables to represent *the system under study*. In a structural equation model, one starts off by dividing these variables into *exogenous* (/independent) variables representing the basis conditions, and *endogenous* (/dependent) variables representing the resulting conditions, with all of these variables allotted a *contrast space* of values serving as the options under consideration. Second, one adds in a *dynamics for the system*, which—in the deterministic case—consists of specifying dependence functions which say, for each endogenous variable, what value it takes as output given input values for certain other variables (which thereby count as *parent* variables—no parenthood loops are permitted). Third, one adds in an *assignment*, which—in the deterministic case—specifies a unique value for each exogenous variable. Once one has specified the assignment (/set the initial conditions) and the deterministic dynamics, the value of every other variable is uniquely determined.

To illustrate, suppose that one is trying to model how the truth-value of a conjunction $p\&q$ depends on the truth-values of its conjuncts p and q. Then a natural classical model would take the system under study $\boldsymbol{S}^*$ to consist of a pair of exogenous variables P and Q, and one endogenous variable R, each allotted 0 and 1 as options to represent falsity and truth. The dynamics $\boldsymbol{L}^*$ would say that the value of R is determined by the *min*

[14] See Koslicki forthcoming for criticism of my use of structural equation models for understanding grounding. Wilson (2014: 570–5) claims that self-grounding and other grounding loops are possible, which would also constitute a line of criticism to structural equation models (at least in the form I present them). I am not convinced but I lack the space to engage with the examples here.

function on the pair {*P*, *Q*}. And the assignment $\boldsymbol{A}^*$ would set *P* and *Q* to their actual truth-values, which I will suppose is $P = 1$ and $Q = 1$. Formally, this may be stated as:

$$S^* = <\{P,Q\},\{R\},\ R^*>, \text{where } R^* \text{ maps all variables to } \{0,1\}$$

$$L^* = <S^*, \{R <= \min(P,Q)\}>$$

$$M^* = <L^*, \{\langle P,1\rangle, \langle Q,1\rangle\}>$$

Or suppose that one is trying to model how the mass of an H_2O molecule depends on the masses of its atomic parts: the H, the other H, and the O. Working in a Newtonian regime and approximating a bit, a natural model would take the system under study $\boldsymbol{S}^{**}$ to consist of three exogenous variables, *H1*, *H2*, *O*, and one endogenous variable, H_2O, each mapped to the positive reals ($\mathbf{R}^+$) to represent Daltons of mass. The dynamics $\boldsymbol{L}^{**}$ would say that the value of H_2O is determined by the *addition* function on {*H1*, *H2*, *O*} (mass is additive in Newtonian systems). And the assignment $\boldsymbol{A}^{**}$ would set *H1* to 1, *H2* to 1, and *O* to 16 (these are the approximate atomic masses). Formally, this may be stated as:

$$S^{**} = <\{H1,H2,O\},\{H_2O\},\begin{Bmatrix} <H1,\{R\}>,<H2,\{\mathbf{R}^+\}>, \\ <\mathrm{O},\{\mathbf{R}^+\}>,<H_2O,\{\mathbf{R}^+\}> \end{Bmatrix}>$$

$$L^{**} = <S^{**}, \{H_2O = H1 + H2 + O\}>$$

$$M^{**} = <L^{**}, \{<H1,1>,<H2,1>,<O,16>\}>$$

Structural equation models go beyond bare causal and grounding claims, by including a dynamics that codifies how exactly the connection works, in terms of a specific rule mapping the prior inputs to the posterior output. We do not just have a connection. What we have is a connection *as specified by a particular function*. On the causal side, a model representing Brynner's cigarette intake and cancer risk would need to specify a dependence function relating cigarette intake to cancer

risk, which might be a linear function, or one that peaks at 20 cigarettes per day, etc. Likewise with the model of conjunction-dependence just displayed, one can not only say that the conjunct truth-values ground the conjunction truth-value, but also say *how*: the pattern is as given by the *min* function. (That marks the difference between conjunction-type dependence and disjunction-type dependence whose pattern is given by the *max* function.) Likewise with the model of mass-inheritance just displayed, one can not only say that the atomic masses ground the molecular mass, but also say *how*: the pattern is as given by the addition function. And so:

> *First lesson learned*: Structural equation models give one more than just the bare ideology of "this grounds that"; they allow one to make sense of follow-up inquiry into *how exactly* the connection runs by including specific rules mapping the more basic inputs to the less basic output.

Structural equation models also allow one to engage in inference, counterfactual reasoning, and explanation, in part via the dependence functions that specify how exactly the connection works. Given that Brynner actually smoked 100 cigarettes per day, one can infer his actual cancer risk as the output of the relevant dependence function, given the input of 100 cigarettes per day. Having this function also allows one to engage in counterfactual reasoning as to what Brynner's cancer risk would have been had he smoked 0, or 20, or 200 cigarettes per day, and to underwrite explanatory claims as to why Brynner developed lung cancer.[15] Likewise with the model of conjunction-dependence: one can infer that the conjunction is true given the actual truth of its conjuncts, one can reason counterfactually that the conjunction would have been false if a given conjunct had been false, and one can underwrite an explanation as to why the conjunction is true. And likewise with the model of mass-inheritance: one can infer that the mass of the H_2O molecule is 18 Da

[15] There is dispute as to how best to treat causal explanation within the structural equation model formalism. See, for instance, Woodward and Hitchcock 2003, and also Halpern & Pearl 2005. This dispute concerns how to use the resources of the formalism to best capture the idea of causal explanation. But what is not in dispute is that the resources needed to make sense of causal explanation are in place.

given the actual masses of its atomic parts, one can reason counterfactually as to what mass the molecule would have had if the atomic parts had had different masses, and one can underwrite an explanation as to why the H_2O molecule has a mass of 18 Da.

Notice that the formalism itself, and the connections to matters such as inference, counterfactuals, and explanation, is *indifferent* as to which species of causal relation is present. One does not need "red" arrows for pushing or production, and "blue" arrows for pulling or dependence or some other type of causal connection. The mathematics works the same regardless, and the connections to inference, counterfactuals, and explanation are the same regardless. In this way, structural equation models justify causal monism, by outfitting the notion of causation with uniform rules and thereby allowing one to say something informative and worthwhile about causal relations generally.[16]

Exactly the same case can be made for grounding monism, given a structural equations model treatment. The mathematics does not care which of Wilson's "small-'g'" grounding relations is present. One does not need "red" arrows for composition and blue arrows for "realization" or some other type of metaphysical connection. The mathematics works the same regardless, and the connections to inference, counterfactuals, and explanation are the same regardless. And so:

> *Second lesson learned*: Structural equations models are embedded in a formalism that outfits grounding with unified rules and so reveals useful generalizations one would miss without the notion.

Corollary: *the notion of grounding has exactly the same claim to unity as the notion of causation*.

Putting this together, in the case of causation the technology already exists to go beyond bare causal claims, and to articulate exactly how cause and effect are connected, as well as to embed causation in a formalism which treats the notion in a unified way and reveals useful generalizations about inference, counterfactuals, and explanation which one would miss

[16] Pearl (2010: 72) offers exactly this style of reply to the pluralist Cartwright (2007), challenging her "to cite a single example" that does not fit his unitary structural equations formalism.

if one refused the notion. This technology smoothly extends to grounding. And so one finds a ready-made way to take up Wilson's lessons and to reach an informative conception of grounding, while making sense of the deep analogies between causation and grounding as relations of directed dependency, and while understanding the special power both relations have of giving us explanatory handles on the world. So I conclude that Wilson has lessons to teach the grounding theorist, but equally the grounding theorist has ways to learn these lessons.[17]

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[17] Thanks especially to Jessica Wilson, and also to Kenneth Aizawa, Ross Cameron, Janelle Derstine, Kit Fine, Kathrin Koslicki, Jon Litland, Meghan Sullivan, and audiences at the 2014 Eastern APA, Fordham, and the *Composition and Ground Workshop* (2015) at Rutgers-Newark.

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