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abstract

An attractive picture of the world is that some features are metaphysically fundamental and others are derivative, with the derivative features grounded in the fundamental features. But how do we have *justified beliefs* about which features are fundamental? What is the epistemology of fundamentality? I sketch a response in this paper. The guiding idea is that the same properties cause the same experiences. I argue that a probabilistic connection between epistemic fundamentality and metaphysical fundamentality is sufficient for justified beliefs about the metaphysically fundamental.

Keywords: metaphysical fundamentality, epistemic fundamentality, scrutability, similarity, probability

Can we have Justified Beliefs about Fundamental Properties?

Penultimate version. Forthcoming in Philosophical Quarterly

1. Introduction

An attractive picture of the world is that some features are metaphysically fundamental and others are derivative, with the derivative features grounded in the fundamental features. There has been an explosion of interest in grounding and fundamentality in recent years.¹ But there has been very little discussion of a key epistemological question – how do we have *justified beliefs* about which features are fundamental?² A vocal minority of those working in metaphysics – and perhaps many not working in metaphysics – think that there is no good answer to this question. I will offer an answer.

I will defend a theory of fundamental properties which shows how we can have justified beliefs about which properties are fundamental. Crucially, the fundamental properties are those which are most similar, especially with regard to causal powers. The theory will use a principle allowing us to connect epistemically fundamental concepts with metaphysically fundamental concepts.³ This theory leaves open to what extent the concept of fundamentality might be extended beyond application to properties.

I will argue that the seminal work on fundamentality by David Lewis and others was firmly rooted in science. In recent years the concept has been extended into new areas and at such a level of abstraction that it is easy to lose sight of where it came from. By holding tight to the epistemic root of the concept of fundamentality we can get a better understanding of what it is and the limits of its application.

Let me start with six clarifications. First, I will leave open the exact relation between fundamentality and other concepts in the vicinity, such as grounding. For example, Wilson (2014)

¹ Rather than citing numerous papers, I note that (as of November 2019) the Grounding section of PhilPapers.org, listed by date of publication, shows 50 which are still forthcoming, and the next 50 published in 2018 or later.

² Chalmers (2012) is one of the few to offer an answer, which I compare briefly at the end of section 4.

³ The account is inspired by Carnap (1928). Carnap's key primitive is a recollection of similarity; mine is identity of epistemically fundamental property.

takes fundamentality as primitive and rejects a general grounding relation, while Schaffer (2009, 2016) takes a general grounding relation as primitive. I won't engage with this debate, but expect all sides will be interested in the relation between fundamentality and epistemology.

Second, I will assume that we have a priori justification (though I do not need to assume we have a priori knowledge). I remain neutral on whether a priori justification is due to analyticity, as empiricists prefer, or whether we have some more robust intuition, as rationalists believe.⁴

Third, I will focus on the fundamentality of properties, as Lewis did. Other have since applied the concept of fundamentality to logical terms (Sider 2011) and to objects (Schaffer 2010). I am sceptical about these extensions and will set them aside until section 7.

Fourth, I will set aside familiar scepticism about the external world and about induction. If you don't think that you are justified in believing that you have hands then I will not try to convince you that you can have justified beliefs about which properties are fundamental. Similarly, if you don't think that you are justified in believing that the sun will rise tomorrow then I will not try to convince you that you can have justified beliefs about which properties are fundamental. A sophisticated way to be a sceptic about induction is to agree that induction is reasonable about fundamental properties, but deny that we know which properties are fundamental. This is a scepticism I will be engaging with. A different way to be a sceptic about induction is to deny that induction is reasonable *even about fundamental properties*. I will not be engaging with this sceptic. If you don't think induction is reasonable, ignorance of fundamental properties is the least of your problems.

Fifth, and relatedly, there is the less familiar sceptical question of whether we can know or have justified beliefs about which *properties* are instantiated (Schaffer 2015). I will set aside this sceptical question and assume we can know which properties are instantiated. The critics I am engaging with do not worry that we cannot know which properties are instantiated; they worry that we cannot know which of the instantiated properties are *fundamental*.

⁴ See Russell (2020).

Finally, I will not try to establish a set of principles which determine exactly what we ought to believe about fundamental properties. That would be too ambitious even for straightforward beliefs about medium-sized dry goods. For example, ‘if it looks like a red table, then believe it is a red table’ is false. The agent might have background beliefs (defeaters) such that the appearance of a red table confirms that there is not red table. Nevertheless, we can agree that your visual evidence partially determines what you ought to believe about what’s in front of you. Similarly, my aim is to establish the types of considerations which are relevant to what you ought to believe about fundamental properties. So I won’t be showing how we can answer to difficult questions like ‘are relativistic properties better candidates to be fundamental than quantum properties?’. There are two types of easier question I hope to show how we can answer. One is ‘is green a better candidate to be fundamental than grue?’. The other is ‘are properties of physics like mass and spin better candidates to be fundamental than chemical (or biological, psychological, sociological etc.) properties?’

Overview: Section 2 distinguishes two types of objection to fundamentality, section 3 offers a way of understanding metaphysically fundamental properties which allows us epistemic access, section 4 shows how we can have a priori access to the *possible* metaphysically fundamental properties, section 5 shows how we can have a posteriori access to the *actual* metaphysically fundamental properties, section 6 shows how we rule out fundamental higher level properties, section 7 discusses extensions beyond properties and section 8 concludes.

2. Two Challenges

In this section I identify two types of worry about metaphysical fundamentality: that it is unintelligible and that it is undiscoverable.⁵ These are commonly heard in conversation and I will quote two proponents of each worry.

⁵ These do not exhaust all the worries about fundamentality, but they exhaust the worries I discuss in this paper. For other worries see Miller, Kristie & Norton, James (2017) Dasgupta (2018) and Thompson (2018).

i) Unintelligibility

The most radical challenge to work on fundamentality is that the concept is literally unintelligible. Some contemporary philosophers echo the words of the logical positivists who claimed that metaphysics was nonsense. Daly (2012) writes:

if treated as a primitive, '[fundamentality⁶]' is unintelligible. p.81

One way to understand a term is to trace its analytic connections with terms that are already understood. The difficulties facing [fundamentality] theorists' attempts to use this measure is that either the terms appealed to are such close cognates to '[fundamentality]' that they are as obscure as it is, or the terms appealed to are sufficiently and independently clear but their connection to '[fundamentality]' is questionable p.91

To anticipate, my aim is to trace the connections between fundamentality and terms that are already understood.

Hofweber (2009) similarly argues that attempts to explain obscure metaphysical terms usually use obscure metaphysical terms, deriding the enterprise as 'esoteric metaphysics':

The most common way to be an esoteric metaphysician in practice is ... [to] rely on a notion of metaphysical priority: some notion that claims that certain facts or things are metaphysically more basic than other facts or things. These

⁶ Daly uses 'grounding', but is explicitly attacking the entire family of inter-defined terms including fundamentality.

notions of metaphysical priority usually get terms that are very familiar from ordinary discourse, but are supposed to have a distinctly metaphysical meaning... But generally these metaphysicians pull a bait and switch here. They rely on some rather ordinary notion of priority and give an example of A being more basic than B in this ordinary sense, and then claim that this shows we have a handle on priority in a metaphysical sense. p. 268

ii) Epistemic access

Even if fundamentality is intelligible, it is not clear how we can have an epistemic grip on it. One version of the problem takes the form of a dilemma – our epistemic grip must be either a priori or a posteriori, and neither is defensible.

To say that our grip is a priori, we must have ‘a very strong conception of the a priori’ (Titelbaum 2010 p. 493). And surely it is epistemically possible a priori that Newtonian properties like mass are fundamental, and also epistemically possible a priori that quantum properties like spin are fundamental.

Yet if our grip is a posteriori, we seem to run into circularity. It is plausible that which hypotheses are favoured by the evidence depends on which properties are *projectible*, which in turn depends on which properties are fundamental. If so, we cannot appeal to evidence to discover which properties are fundamental. Titelbaum (2010) writes:

Now consider an agent—call him Pedro [who] wants to determine whether his total evidence favors one particular hypothesis over another. Pedro...believes that the evidential favoring relation works with a combination of one’s total evidence and the list of [fundamental] properties. Still, he knows he won’t be able to determine any favorings from his evidence until he has the list of [fundamental] properties. So he sets out to determine the list of [fundamental] properties. Since

the content of that list is an empirical fact, he decides to determine the list from his total evidence. But he knows he can't determine what his evidence favors until he has the list of [fundamental] properties... p.484-5⁷

Warren (2016) argues that the familiar Benaccerraf-style objections to abstract objects apply, and that neither a posteriori nor a priori access to the fundamentality facts is possible:⁸

The problem is simple: the facts about [fundamentality] are objective, mind independent, and causally inaccessible —but [our] attitude-forming cognitive mechanisms are, one and all, causal mechanisms, and this seems to preclude any possibility of plausibly accounting for [our fundamentality] reliability other than by assuming that [we are] very lucky in [our fundamentality] attitudes p.2427

I take it both Titelbaum and Warren are concerned that we have no way to have justified beliefs about fundamentality.

3. Similarity, Causality and Minimality

In this section I will distinguish metaphysical and epistemic fundamentality, then rehearse and elaborate on some widely held claims about metaphysical fundamentality. Then in the following sections I will argue that they provide a path to epistemic access.

⁷ Among many others, see Dorr and Hawthorne [2013]: 'How are we supposed to know—or even, reasonably believe—anything about structure?' p. 18 and Schaffer and Hicks: 'The third main extant challenge to Link—due primarily to van Fraassen ([1989]) and Loewer ([2007])—concerns lack of epistemic access to metaphysically elite properties.'

⁸ Warren is actually discussing Sider's (2011) theory of structure, but I take it the point applies just as clearly to fundamentality. See Bennett (2017) p.141-2 for a related discussion. (A referee tells me that Sider has a theory of the epistemology of fundamentality; but Sider merely gestures at the contentious concept of the 'best explanation' (ch. 2, 2011), assumes we have access to the similarity of facts (ch. 6.1, 2011), doesn't solve this epistemic problem (p.80-82, 2011) and says only that his theory adds no *new* epistemic problems beyond the epistemic problems of Lewis (ch. 6.4, 2011).)

The path rests on a distinction between two types of fundamentality, epistemic and metaphysical:⁹

i. The *epistemically* fundamental is at the base of our access to the world. Paradigm epistemically fundamental properties are sensory properties such as pain or phenomenal blueness. Call our concepts of these properties ‘epistemically fundamental concepts’. (We need not assume we have incorrigible access to these properties.)

ii. The *metaphysically* fundamental is the focus of work in the literature on grounding and ‘fundamentality’, and is what critics claim is obscure. Proponents might say that metaphysically fundamental properties are ungrounded, or do not “ontologically depend” on anything else (Dasgupta 2017), or are perfectly “natural” (Lewis 1983) or “structural” (Sider 2011). One of my aims is to pin down a meaning which is epistemically accessible.

Our concern is metaphysical fundamentality. I will argue that we can get an epistemic grip on metaphysically fundamental properties via their connection to epistemically fundamental properties.¹⁰

It was David Lewis who most clearly laid the foundations for the contemporary interest in metaphysical fundamentality:

⁹ See McDaniel (2017, p.224).

¹⁰ I will not offer a definition of fundamentality. The failures of conceptual analyses indicate that that would be a fool’s errand. I only claim that we have a cluster of concepts that together allow us to get a grip on fundamentality.

There are [the metaphysically fundamental properties¹¹] that there must be to ground the objective resemblances and the causal powers of things. Lewis 1983 p.345

Sharing of [the metaphysically fundamental properties] makes for qualitative similarity, [the metaphysically fundamental properties] carve at the joints, they are intrinsic, they are highly specific, the sets of their instances are ipso facto not entirely miscellaneous, and there are only just enough of them to characterize things completely and without redundancy.¹² Lewis 1986 p.60

We can extract from these comments three qualifications for being a metaphysically fundamental property (Schaffer 2004 p.94):

- (1) Similarity: metaphysically fundamental properties ground objective similarities.
- (2) Causality: metaphysically fundamental properties carve out causal powers.
- (3) Minimality: metaphysically fundamental properties serve as a minimal ontological base.

I will argue that these suffice to give us an epistemic grip on metaphysical fundamentality.

¹¹ Lewis writes 'sparse properties' which we can take to be metaphysically fundamental properties. Bennet (2017 section 5.8) would object, distinguishing Lewis's natural properties from her fundamental (or 'independent', in her terminology) properties. But this means Bennett cannot use my solution to the problems of section 2, which risks 'independent' becoming mysterious. (I leave open that an indirect connection might be made (see Kovacs forthcoming)). Bennett offers several arguments, with the most important (in her judgment) being that we have no reason to 'think that a single phenomenon plays the naturalness role' (p.134). I agree that we have no *a priori* reason to think that a single phenomenon plays the naturalness role, in which case I think it is indeterminate what is natural/fundamental (see the end of section 4).

¹² Why can't the metaphysically fundamental properties be read off Lewis' best system analysis of laws? Because which system is best will depend on which are the metaphysically fundamental properties (see Lewis 1983, pp. 367-368).

Someone might object that we lack justification for 1-3. The first thing to say in reply is that this objection is dialectically off-topic. The dissidents of section 2 do not deny the truth of 1-3; they deny that 1-3 (or anything else) can provide epistemic access to the metaphysically fundamental properties. My strategy is to argue that 1-3 can provide us with epistemic access to metaphysical fundamentality.

Still, how might 1-3 be justified? In order to avoid circularity, we need a priori justification for 1-3. Some worry that there is no a priori justification at all, but, as noted above, this worry would also be dialectically off topic. The dissidents of section 2 are not denying the a priori.

A more relevant objection is that 1-3 use terminology that is so obscure that they cannot help us get an epistemic grip on fundamentality. To address the worry, let's have a closer look at 1-3 and the concepts of *objective similarity*, *ground*, *carving out*, *cause*, and *minimal ontological base*.

Starting with (1), '*objective similarity*' is a contentious concept, and one might wonder how we can have justified beliefs about what is objectively similar. Section 5 is largely devoted to showing how we can, positing a connection between the metaphysically fundamental and the epistemically fundamental.

'*Ground*' has appeared in (1), which appears to threaten obscurity or circularity. A first response is that 1-3 give us several a priori connections, so it is not fatal to have the same (or related) concepts appear in two different places. For example, the concept of belief can be defined in part by the causal power to cause other beliefs, but this doesn't make the definition viciously circular. A second response replaces 'ground' with 'explain': (1') metaphysically fundamental properties explain objective similarities. Someone might object that 'ground' and 'explain' are too closely connected for this move to be helpful. But we are just looking for terms which we understand, and I think we do understand the concept of explanation.¹³

¹³ I cannot defend a theory of explanation here, but I think explanation could be understood in terms of rationality, inference, representation, ability and possibility e.g. sentence A explains sentence B iff a rational agent could infer B from A. This might require explanations to be representations rather than events/parts of the world (see Bokulich 2018).

Moving on, let's have a closer look at:

(2) Causality: metaphysically fundamental properties carve out causal powers.

One way in which things can be similar is by having the same (or similar) causal powers, so (2) Causality is a special case of (1) Similarity. Thus we might simplify our account by deleting (2). Still, as (2) will be central to our discussion it is worth keeping it explicit.

The appearance of the metaphor of *carving out* in (2) is troubling. I take it the idea is that instances of the same metaphysically fundamental property will tend to have the same effects. So a more explicit claim which we will use below is:

(2+) Causality+: instances of the same metaphysically fundamental property will tend to cause the same properties to be instantiated.

That is, if one instance of F (a metaphysically fundamental property) causes G, then other instances of F will tend to cause G. Let's apply this to a familiar example. Compare the causal profile of pain according to the identity theory (e.g. pain=c-fibres activated) with that of the functionalist theory (e.g. pain=the state caused by bodily damage). A wide range of states can be caused by bodily damage, so pain is highly disunified for a functionalist, and we would expect creatures in functionalist-pain to differ in their causal profiles (despite the similarities needed to count as being in pain). They would certainly differ more than creatures in identity-theory-pain (with c-fibres activated). For example, creatures with c-fibres activated would be more likely than creatures in functionalist-pain to produce the same chemicals in response to pain and to respond to specific drugs as painkillers.

Someone might think that objects with similar metaphysically fundamental properties can have very different causal powers. One example is that *existence* might be a fundamental property, but existing things can have all manner of causal powers. (Existence is controversial, but the point can be

made with other properties which apply broadly, such as having mass.) Another example is in *chaotic* systems, where very similar initial conditions can have highly divergent effects.

In response, we will only need a probabilistic comparative principle. Objects with similar metaphysically fundamental properties are *more likely* to have similar causal powers than those without. Consider a double-rod pendulum, one of the simplest chaotic systems. I concede that slight differences in the initial position of the rods lead to very different futures; but we are likely to get *drastically* different futures if we alter the fundamental properties involved. For example, if we change materials so the rods are made of iron and the joint between them is made of polystyrene, then we get the drastically different pattern of the rods lying on the floor. And if we make the rods of a combustible material then we might get a drastically different future in which the rods catch fire.

'Causal' in (2) does not present any relevant epistemic problems. Humeans define causation in terms of epistemically unproblematic constant conjunction. Other theories of causation might be epistemically problematic, but proponents of those theories obviously think they can be solved. I invite you to use your favourite theory of causation. Those who reject the concept of causation might get off the boat at this point, but that seems like the right result, as those who reject the concept of causation will probably also reject the concept of fundamentality.

Finally, let's have a closer look at:

(3) Minimality: metaphysically fundamental properties serve as a minimal ontological base.

'Ontological base' might look obscure, but we can understand the ontological base in terms of *necessitation*: an ontological base is a set of properties which necessitate all the properties there are. For example, in a world with charge, a purported ontological base with only the property of mass would not be an ontological base. (Notice we only use the intensional concept of necessitation, avoiding hyperintensional concepts which some think are obscure.)

A '*minimal*' ontological base adds that no feature is redundant. For example, a purported minimal ontological base of mass, charge and *mass-or-charge* would not be minimal, as reference to *mass-or-charge* would be redundant. Notice that it is sets of properties which can form a minimal ontological base, so our ultimate judgments about fundamentality will involve sets of properties which best satisfy (1) and (2) individually and (3) collectively.

Schaffer (2004) rejects (3) Minimality on the grounds that it is possible that we live in an infinitely complex onion universe with no bottom level. No properties would satisfy Minimality, but 'all the roles that the [fundamental] properties play still need to be played' (2004 p.99). Schaffer concludes that the non-redundancy condition is not a qualification of fundamentality. I'm not convinced, but will not discuss this here as Minimality will not play a major role in my arguments. I set it aside until section 6, where I will make explicit where it is needed.

To bring this together, I will argue that metaphysical fundamentality is epistemically non-fundamental, and we can connect metaphysical fundamentality to epistemically unproblematic concepts using Similarity, Causality and Minimality.

4. A posteriori vs a priori.

How does all that help us discover which properties are metaphysically fundamental? We first need to decide if our access is a priori or a posteriori in order to answer Titelbaum's objection.¹⁴ My answer is that our access to which properties are possibly metaphysically fundamental is a priori (section 4) and our access to which properties are actually metaphysically fundamental is a posteriori (section 5).

So I defend the following two claims:

Actual

We cannot discover a priori which metaphysically fundamental properties are actually instantiated in our world.

¹⁴ See Hawthorne and Dorr (2013).

Possible

We can discover a priori which metaphysically fundamental properties are possible

i.e. of the possible properties, which are metaphysically fundamental.¹⁵

I take it *Actual* is uncontroversial. We cannot tell a priori whether we are living in a Newtonian or a relativistic universe, and different metaphysically fundamental properties will be *instantiated* in those universes.¹⁶

But I claim that we can tell a priori whether a property *would be* metaphysically fundamental *if instantiated*. Specifically:

Possible+

Given a sufficiently rich description of a possible world (not including concepts like ground or fundamentality¹⁷, nor information about which world is actual), a rational agent would be able to form a priori justified beliefs about which properties of that world are metaphysically fundamental.

Let's start with an example. Surely we can tell a priori that there is something wrong with *grue* as a candidate for metaphysical fundamentality. We do not need to know whether *grue* is instantiated, nor do any experiments with *grue* things. Mere reflection on the property is enough to tell us that it is not metaphysically fundamental. And our account above can explain why – mere reflection on *grueness* is sufficient for us to determine that it scores relatively poorly on Causality and Similarity.

¹⁵ Hedden (2016): '[I]t is a priori which properties are possibly natural, and being possibly natural and actually instantiated is necessary and sufficient for being natural.' p.726. See also Hildebrand (2019). Lewis (1986 p.60-61) makes the stronger claim that metaphysically fundamental properties are necessarily metaphysically fundamental, but this requires claims of trans-world property identity that we don't need.

¹⁶ This worry seems to motivate Loewer (2007), Cohen and Callender (2009) and Titelbaum (2010).

¹⁷ Without this clause *Possible+* would be trivially true.

Specifically, *grue* things are less similar, and have causal powers that differ more, than green things. (Minimality seems neutral between green and *grue*.)

Or consider a Newtonian world *w*, instantiating mass, momentum and tablehood, among other properties. Given a total description of *w* in terms of the mass, momentum, tablehood, and other properties (not including fundamentality nor related properties like being grounded), we could work out which properties are fundamental. We don't need further information about *w* to ascertain which properties are metaphysically fundamental in *w* – we can ascertain a priori that mass is metaphysically fundamental in *w*, while momentum and tablehood are not, in virtue of mass better satisfying Minimality, Causality and Similarity. We don't need information about whether *w* is actual or merely possible.¹⁸

More generally, imagine a wide variety of physics textbooks describing the laws of different possible worlds – finding that one has an 'actuality' stamp on the back is irrelevant to deciding which properties are metaphysically fundamental in the world described by each textbook. Instead, we can assess each property for Minimality, Causality and Similarity given a textbook.

We can now answer Titelbaum's objection. Titelbaum writes '[Pedro] sets out to determine the list of [metaphysically fundamental] properties. Since the content of that list is an empirical fact...'. But 'the list' is ambiguous between the list of *possible* metaphysically fundamental properties and *actual* metaphysically fundamental properties. Only the content of the list of *actual* metaphysically fundamental properties is an empirical fact. I have argued that the content of the list of *possible* metaphysically fundamental properties can be determined a priori.

It might be useful to think of Pedro as having established his Bayesian prior probability function and no more.¹⁹ This probability function encodes what he should believe given any specific

¹⁸ The details of exactly what information we need will depend on our theory of laws e.g. a regularity theorist will need different information than a universals theorist.

¹⁹ Or a set of them if we think multiple priors can be rational (see White 2005 for an argument that only one can be rational).

set of evidence, so it determines whether his total evidence favours one particular hypothesis over another.

Let's compare a related thesis tentatively endorsed by David Chalmers. (Terminology: If an expression is epistemically rigid and metaphysically rigid then it is super-rigid. A super-rigid truth is a truth expressed with only super-rigid expressions. One truth is conceptually grounded in another when it is analytically entailed by those truths and those truths are conceptually prior to it.).

Conceptual/Metaphysical (C/M) Thesis

When A and B are super-rigid truths, A conceptually grounds B iff A metaphysically grounds B. (Chalmers 2012 p. 453)

Chalmers, like me, is suggesting a way we might have a priori epistemic access to metaphysical fundamentality. But the neat correspondence between conceptual/epistemic and metaphysical grounding that Chalmers suggests seems too tight to me.²⁰

Instead, I make the weaker claim that there is some way of reasoning a priori from a rich description of a world to the metaphysically fundamental. In the next section I will argue that there is some way of reasoning a priori from the epistemically fundamental to the metaphysically fundamental. (In Chalmers' terminology, I am arguing that the metaphysically fundamental truths are scrutable (i.e. can be derived a priori) from the epistemically fundamental truths.)

Three other points are worth noting. First, I focus on the connections between concepts and properties rather than sentences. Second, Chalmers only allows analytic inferences, while I allow any a priori inferences. Third, although I don't talk about rigidity, the epistemically fundamental concepts

²⁰ Perhaps we have a counter-example: 'S's neural circuit 135 is firing' metaphysically grounds 'S experiences phenomenal redness' but does not conceptually ground it. This purported counter-example might not succeed, as some of the terms might not be super-rigid. But I suspect the counter-example could be fixed e.g. sentences with our basic spatio-temporal concepts seem to conceptually ground sentences about spacetime in physics without metaphysically grounding sentences about spacetime in physics. Furthermore, even if there is no counter-example, the restriction to super-rigid terms gives C/M limited applicability.

I use are good candidates to be super-rigid. Relatedly, epistemically fundamental concepts come with an especially direct grip on the corresponding entities in the world.²¹ For example, the concept of phenomenal red comes with an especially direct grip on phenomenal redness. By contrast, given standard Kripkean assumptions, 'being water' refers to the property of being H₂O, but this cannot be known a priori. Chalmers and I both want to rule out the claim that a description of the world using concepts like *water* allows access to metaphysical fundamentality, and this can be done using the concepts of rigidity, transparency or epistemically fundamental properties.

Let's consider an objection. Couldn't we describe the same world in two different ways?²² If so, couldn't we get different verdicts about which properties are metaphysically fundamental in a world depending on how it was described? For example, quantum phenomena might be described using wave mechanics or matrix mechanics. These are mathematically equivalent, but suggest different metaphysically fundamental properties.

I suggest that we would simply compare the two candidate sets of properties by rating them by Similarity, Causality and Minimality. If one set scored higher, that set would be metaphysically fundamental.

The objector could continue that there might be no clear answer. It's possible that one set of properties gets a higher score on one qualification (e.g. Similarity) and another set of properties gets a higher score on a different qualification (e.g. Causality). Alternatively, one set of properties might get a higher score on one type of similarity while another set of properties gets a higher score on a different type of similarity.

I agree, and don't see this as an objection. We should allow possibilities where it is indeterminate what the metaphysically fundamental properties are.²³ A set of properties deserves the name of metaphysically fundamental to the extent that it satisfies Similarity, Causality and

²¹ They are 'transparent concepts'; see Chalmers (2012 p.372) and (Goff 2011).

²² See Warren (2016 section 1).

²³ This will be incompatible with views which hold that it is determinate what is fundamental. Sider 2011 (ch. 7.12) defends the related (but distinct) view that determinacy is not fundamental.

Minimality. If in some world no set of properties perfectly satisfies Similarity, Causality and Minimality then no set of properties perfectly deserves the name.²⁴ If nature is kind then one set of properties will be so far ahead of its rivals that it will determinately be the metaphysically fundamental set of properties. We have no guarantee that in our world nature is kind in this way, but no evidence that it isn't. Perhaps we presuppose it in our thinking about fundamentality. If in our world nature were unkind then perhaps it would be indeterminate which properties were metaphysically fundamental, but I'd blame the trouble on unkind nature, not the analysis.²⁵

This section argued for the relatively weak claim that we could form justified beliefs about which properties are metaphysically fundamental in a world *given a sufficiently rich description* of the world. But do we have a sufficiently rich description of the actual world? In the next section I will argue that we do by showing how we can connect our experiences with metaphysically fundamental properties.

5. Metaphysics-to-Epistemology

Zoom in on the actual world. How could we discover the actual metaphysically fundamental properties? Our epistemic starting position involves a set of epistemically fundamental properties. We move around the world and find ourselves with epistemically fundamental properties e.g. being in pain, experiencing phenomenal blueness. How do we work out which are the metaphysically fundamental properties? How can we make an inference from a description of a world using epistemically fundamental properties to a description of that world using metaphysically fundamental properties? What assumptions must be in place?

The key assumption was identified in section 3:

²⁴ The onion world of infinite descent discussed by Schaffer (2004) would be such a world. Schaffer infers that Minimality is not a qualification of fundamentality; I suggest that Minimality is a qualification of fundamentality which is unsatisfied in such a world.

²⁵ I base this paragraph on two passages from Lewis (1994), where he discusses laws (p.479) and chances (p.489).

(2+) Causality+: instances of the same metaphysically fundamental property will tend to cause the same properties to be instantiated.

We need a special case of this principle:

Metaphysics-to-Epistemology, Unmodified

Instances of the same metaphysically fundamental property will tend to cause the same *epistemically fundamental* properties to be instantiated²⁶

This gives us the link needed between metaphysics and epistemology.

Two modifications will make this principle more usable. First modification: the principle above leaves no room for collections of properties and the resulting complications. Modifying the principle to refer to objects allows for these complications:

Metaphysics-to-Epistemology (M-E)

Objects sharing a relatively high number of metaphysically fundamental properties will tend to cause the same *epistemically fundamental* properties to be instantiated

Second modification: Even if metaphysical sameness causes epistemic sameness, perhaps metaphysical *difference* also causes epistemic sameness. Then epistemic sameness will be no guide to metaphysical sameness. So we need a comparative claim, arriving at:

Comparative M-E

²⁶ This idea can be found in what Psillos (2001 p.14) calls the Helmholtz-Weyl principle: If two stimuli are identical, then the resulting percepts are identical.

Objects sharing a relatively high number of metaphysically fundamental properties are more likely to cause the same epistemically fundamental properties to be instantiated than objects not sharing a relatively high number of metaphysically fundamental properties

Compare this to a strong Chalmers-style claim: the truths about the metaphysically fundamental properties are scrutable from the truths about the epistemically fundamental properties.²⁷ Scrutability requires that knowing the truths about the epistemically fundamental properties puts one in a position to *know* the truths about the metaphysically fundamental properties. I am making a weaker claim. My claim is only that knowing the truths about the epistemically fundamental properties puts one in a position to form *justified* beliefs about the metaphysically fundamental properties. And this follows from *Comparative M-E*. (I do not claim *Comparative M-E* is necessary for us to have justified beliefs. Perhaps something weaker will do.)

Let's go through an example. Suppose an agent is looking at two red apples each reflecting light at 700nm (a metaphysically fundamental property, we can assume). *Comparative M-E* says that these apples are more likely to look the same to the agent than a red apple and a yellow lemon. Put the other way, suppose an agent has a visual field with two areas of phenomenal redness (an epistemically fundamental property, we can assume). These areas of phenomenal redness are more likely to be caused by the same metaphysically fundamental property than by different metaphysically fundamental properties. By contrast, if an agent is looking at a red apple and a yellow lemon, then they are more likely to look different to the agent than when looking at two red apples. And if the agent has a visual field with one area of phenomenal redness and one area of phenomenal yellowness then they are more likely to be caused by different metaphysically fundamental properties than the same metaphysically fundamental properties.²⁸

²⁷ I don't know if Chalmers endorses this.

²⁸ Clarification: I am not relying on experiences which appear to be of the same metaphysically fundamental properties. Being the same metaphysically fundamental property is quite a theoretical idea, and I'm not sure

It is worth emphasizing that *Comparative M-E* is a probabilistic principle.²⁹ It does not say that objects sharing a relatively high number of metaphysically fundamental properties *always* cause the same epistemically fundamental properties to be instantiated. So it allows for possibilities in which objects sharing a relatively high number of metaphysically fundamental properties do not cause the same epistemically fundamental properties to be instantiated.

These are sceptical possibilities. One such possibility is where we cannot detect some metaphysically fundamental properties. Then these metaphysically fundamental properties will not cause *any* epistemic properties. *A fortiori* they will not cause the same epistemically fundamental properties. Perhaps there are ghost-like entities moving among us which do not have any effect on us. Or perhaps some metaphysically fundamental properties are undetectable quiddities (Lewis 1999).³⁰ Or perhaps we are wired such that metaphysically *non*-fundamental properties always cause the same effects in us (even if we use laboratory equipment). In such possibilities we are not in a position to discover the metaphysically fundamental properties. There is no guarantee that we are not irremediably ignorant of the metaphysically fundamental properties, and I take this to be a virtue of the account - an objective theory should allow the possibility of uncorrectable error. But there is no reason to think we are in such an unfortunate position. We should not confuse the *possibility* that we cannot discover which properties are metaphysically fundamental from Titelbaum's worries that our *actual* situation is one in which we cannot discover which properties are metaphysically fundamental (or even worse that *necessarily* we cannot discover which properties are metaphysically fundamental).

We can now return to Warren's objection that we cannot have justified beliefs about objective, mind independent, and causally inaccessible features. I agree. But I claim that metaphysical

we have experiences which appear to be of the same metaphysically fundamental properties. My claim is that given experiences of the same epistemically fundamental property, we can make justified inferences about metaphysically fundamental properties.

²⁹ It is as an inductive/rational a priori probability function. This contrasts with objective chance, and with subjective probabilities which have no rationality constraints (Hawthorne 2021).

³⁰ Better (due to Schaffer 2005): They are detectable, but not in a way that allows us to distinguish one world from an alternative, in the way required for us to discover which are actual. (Schaffer rejects Lewis's scepticism.)

fundamentality is causally accessible. Sharing of metaphysically fundamental properties by objects makes for similarity, including similarity in their causal powers. We can detect similarity of causal powers, so we can detect metaphysical fundamentality.³¹

Let's consider four objections. First, someone might object that an electron in one experimental setup can cause very different experiences to an electron in a different experimental setup. *Comparative M-E* would wrongly say that the electrons therefore probably do not share a high number of metaphysically fundamental properties.

In response, the experimental setups will involve various metaphysically fundamental properties. Differences in experiences caused by electrons will be attributable to differences in the experimental setup, which in turn will be attributable to differences in metaphysically fundamental properties.³² Electrons themselves all behave exactly the same – once you've seen one electron you've seen them all.³³

Second, someone might make the analogous objection moving in the opposite direction. Gold and fool's gold can cause very similar experiences, so *Comparative M-E* would wrongly say that they probably share metaphysically fundamental properties.

In response, gold and fool's gold might cause the same epistemically fundamental properties across a range of circumstances, but given the right experimental setup, samples of gold will cause one set of epistemically fundamental properties and samples of fool's gold will cause another. After all, if gold and fool's gold caused the same epistemically fundamental properties across *all* known circumstances we would infer that they were the same thing i.e. have the same metaphysically

³¹ We can remain neutral on whether being metaphysical fundamental is itself causally efficacious. Presumably being fundamental is a property of properties i.e. a second-order property. Compare: The second order (functional) property of having some first order property that causes one to take an umbrella is detectable. We just look for who takes an umbrella. It is an open question whether the second order property has causal powers.

³² This is compatible with objective chance. An electron might go through either slit A or slit B, but one electron going through slit A will probably cause the same experiences as the next electron going through slit A.

³³ This line is attributed to Steve Weinberg at <https://www.discovermagazine.com/the-sciences/the-standard-model>.

fundamental properties. Our actual judgement that they have different metaphysically fundamental properties is based on the different epistemically fundamental properties they cause.³⁴

Third, there is the worry that properties are cheap and therefore *Causality+* doesn't rule anything out. Recall:

(2+) *Causality+*: instances of the same metaphysically fundamental property will tend to cause the *same* properties to be instantiated (italics added).

The worry is that any property instances can count as instances of the same property. Having a grue experience (i.e. having a green experience before 2000 or a blue experience after 2000) is still a property, and grue things cause grue experiences. So we can start with *Causality+* and substitute in grueness: instances of grueness will tend to cause the same (grue) experiences to be instantiated. *Causality+* seems to be compatible with grue being metaphysically fundamental and therefore puts no limitations on what is a metaphysically fundamental property. Put abstractly, *Causality+* is intended to show that only a special class of properties (the metaphysically fundamental ones) tends to cause the same properties to be instantiated; but if properties are cheap then everything will tend to cause the 'same' properties to be instantiated.

In response, we need a way to rule out gruesome properties. We cannot do so by appeal to the metaphysically fundamental properties because their intelligibility and accessibility is exactly what is in doubt in this debate. But we *can* rule out gruesome properties by appeal to epistemically fundamental properties. Our phenomenology allows us to identify two green experiences as being instantiations of the same property, and two grue experiences (one green and one blue) as being instantiations of different properties. Having a grue experience is *not* the type of property referred to in *Causality+* (in the second position); having a green experience *is* the type of property referred to in

³⁴ Specifically, fool's gold is harder and less easily scratched. The same point applies to other familiar examples such as water and XYZ (Kripke 1972, Putnam 1973).

Causality+ (in the second position). We stipulate that that's how *Causality+* is to be understood. And this becomes explicit once we move to *Metaphysics-to-Epistemology, Unmodified*.

Fourth, someone could block the inference from *Causality+* to *M-E* by agreeing that metaphysically fundamental properties tend to cause the same properties overall, but not the same *epistemically* fundamental properties. Perhaps epistemically fundamental properties do not line up neatly with metaphysically fundamental properties.

I agree that this is possible, but it is unmotivated. Why would we expect epistemically fundamental properties to fail to line up with metaphysically fundamental properties? I see no reason. In fact, I think we have extra reason to expect that *epistemically* fundamental properties will line up with metaphysically fundamental properties. As Quine (1969) pointed out, creatures whose sensory organs better detect metaphysically fundamental properties will be more successful under natural selection. Getting to grips with the causal structure of the world will be particularly important for creatures who need to know if an apple will cause them to be nourished or to get sick. Creatures for whom apples look completely different on different occasions will be at a competitive disadvantage compared to a creature for whom apples always look the same. So we would expect evolved creatures to be attuned to the causal structure of the world, which in turn would be helped by being attuned to the metaphysically fundamental properties. So we have good reason to think that *Comparative M-E* will be true in evolved creatures.

Given this evolutionary argument, why bother with the more general argument using *Causality+*? I think the evolutionary argument is not dialectically effective by itself, as the objector might reply: the more successful creatures will be those whose sensory organs better detect properties that are important for their *survival*. But why think those are the metaphysically fundamental properties? To answer this question we need the more general principle that instances of the same metaphysically fundamental property will tend to have the same effects. Furthermore, our belief that we evolved is based on evidence which requires assumptions about projectibility to

assess, leading us back to Titelbaum's problems with Pedro above. So we cannot avoid a priori principles.

6. Why aren't Chemical Properties Metaphysically Fundamental?

Hofweber (2009) writes:

I can't wait for the first metaphysician to come out and defend that everything is water...Water is the most fundamental of all things. Of course, water is H₂O, and so made up from other stuff, but that is the wrong sense of priority. Water is metaphysically more basic than both H and O, though physically H and O might well be more basic. p.273

Sure enough, Bernstein (2021) discusses the view that 'middle-level' things like water are fundamental, and, although she doesn't defend it, she argues for its plausibility. We can imagine Hofweber shaking his head and muttering "here we go...". We need a way to answer our question: 'are properties of physics like mass and spin better candidates to be fundamental than chemical (or biological, psychological, sociological etc.) properties?'

I will argue that Minimality supports the 'yes' answer and rules out being water as fundamental.³⁵ (Similarity and Causality are not needed.) Let's set aside the fact that many things are not made of hydrogen, oxygen, or combinations of them (e.g. gold). What should we say about the stuff that is made of hydrogen, oxygen, or combinations of them? Why are being hydrogen and oxygen better candidates to be metaphysically fundamental than being H₂O? Here we can appeal to Minimality, which requires that the metaphysically fundamental properties allow us to describe the world completely and without redundancy.

³⁵ Note that Hofweber and Bernstein both discuss objects, but I discuss properties here. I take it Hofweber's point can easily be translated into talk about properties e.g. 'being oxygen', so won't fuss about distinction. The connection to objects is discussed in the next section.

Suppose, for reductio, that we posit being H₂O as a metaphysically fundamental property. How do we reduce this to absurdity? First, we note that a *complete* description of the world must include the oxygen and hydrogen that is not part of H₂O e.g. the free-floating gas O₂.

There are then two options for the middle-leveiler: either being oxygen and being hydrogen are *also* fundamental, or they are not. If being oxygen and hydrogen are *not* also fundamental then a description of the world in terms of the metaphysically fundamental properties will omit any reference to gaseous hydrogen and oxygen, which violates Minimality's requirement of *completeness*. (We can allow that in some possible worlds hydrogen and oxygen are only found in H₂O, and in such worlds perhaps being H₂O is metaphysically fundamental, but that is not our world.)

(What if, following Schaffer (2004), we reject Minimality? We would still be able to use this type of response, as Schaffer rejects only the non-redundancy condition of Minimality, not the completeness condition. If there are fundamental properties then they serve as an ontological base for everything, and H₂O cannot serve as an ontological base for free-floating O₂.)

The second option is to posit being hydrogen and being oxygen as metaphysically fundamental properties, *as well* as H₂O. But once the distribution of hydrogen and oxygen is fixed, the distribution of H₂O is fixed, so claims about H₂O are redundant, violating Minimality's requirement of *non-redundancy*.

(What if, following Schaffer (2004), we reject non-redundancy? Then we could not argue against H₂O being fundamental in this way. I am optimistic that Similarity and Causality could be used to identify being oxygen as more fundamental than being water, but will not develop this thought here.)

7. Extensions

My main aim has been to show that talk of metaphysical fundamentality need not be mysterious. But before closing, I want to raise the question of extending this account from properties to other ontological categories like objects, logical terms or facts.

Are there metaphysically fundamental *objects*? If so, how big are they? Plausible options include:

- a. points
- b. basic particles posited by ideal physics
- c. medium sized objects
- d. the cosmos.

How might we decide between them? We might try to use versions of our principles modified for objects:

- (1) Object-Similarity: metaphysically fundamental objects ground objective similarities;
- (2) Object-Causality: metaphysically fundamental objects carve out causal powers;
- (3) Object-Minimality: metaphysically fundamental objects serve as a minimal ontological base

But they all look problematic. Very briefly, Object-Similarity doesn't help, as two objects of various sizes can be maximally similar. For example, two water molecules are as similar as two electrons, despite being different sizes.³⁶ Object-Causality looks problematic, as it is standard to assume that *properties* rather than objects carve out causal powers. Object-Minimality doesn't help because a, b, c and d all satisfy Minimality. Indeed Minimality is satisfied by any collection satisfying the *tiling constraint* - 'no gaps, no overlaps' (Schaffer 2010 p.38).

So it seems we require a different methodology to discover the fundamental objects. One suggestion is that the fundamental objects are those which bear the fundamental properties. The

³⁶ The cosmos, being everything, is not similar to anything, so we cannot apply Similarity

problem here is that all candidate fundamental properties can be instantiated by overlapping objects e.g. tables and parts of tables can have, mass, charge, be entangled etc. Another thought is that the fundamental objects are the ones which explain everything else in the simplest way when combined with the fundamental properties (and the laws). Perhaps this will give different results in different worlds. In a classical world, the properties of the table are best explained by reference to the particles that constitute it, so the particles are fundamental. In a quantum world, the properties of the table are best explained by reference to the rest of the universe, so the universe is fundamental.³⁷

I have no objections here, but I do want to note something odd about combining a theory of fundamental properties with a theory of fundamental objects. According to the bundle theory, once we have told the whole story about properties, we have told the whole story. There is nothing else. So the bundle theorist will consider a theory of property fundamentality to be a complete theory with no role left for a theory of object fundamentality. And even if you reject the bundle theory, there is not much left of objects once the whole story about properties has been told. We are left with thin particulars, or haecceities,³⁸ and these are not substantial enough for some to be fundamental and some to be derivative. So it seems uncomfortable to try to combine a theory of property fundamentality with a theory of object fundamentality.

A related question is whether there are metaphysically fundamental *logical terms*. For example, are quantifiers or connectives metaphysically fundamental? But how do we discover which logical terms are fundamental? Sider (2011 section 6.1) suggests that the fundamentality of logical terms can be explained via similarity, in particular the similarity of facts. Thus the existential quantifier is fundamental because existential facts are similar. But how do we discover whether facts are similar? The answer is not obvious, and Sider does not offer an account.

One suggestion is that the fundamentality of facts can be derived from the fundamentality of the properties and objects that constitute those facts. But developing this will take some care – ‘Mary

³⁷ This seems to be the strategy implicit in Schaffer (2009 section 2.2).

³⁸ See Sider (2006)

loves Bill' is simpler than 'Mary loves Bill or Mary', despite both facts containing the same objects and properties.

To be clear, I see no principled reason why we can't extend an epistemically acceptable theory of fundamental properties to provide an account of fundamental objects or facts, but it will not be straight-forward.

8. Conclusion

I have suggested a methodology for identifying the metaphysically fundamental properties based on a link between the metaphysically fundamental and the epistemically fundamental. Given some plausible anti-sceptical assumptions, it follows that we can have epistemic access to the metaphysically fundamental properties. My main aim has been to show that talk of metaphysical fundamentality need not be mysterious. Nevertheless, we should be cautious when extending these concepts beyond properties. It is not obvious how to extend these ideas to other ontological categories like objects, facts or logical terms.³⁹

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³⁹ Thanks to Jared Warren and Jonathan Schaffer for helpful feedback on earlier drafts.

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