Opacity in the Book of the World?

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This is a preprint of an article forthcoming in *Philosophical Studies*

Abstract

This paper explores the view that the vocabulary of metaphysical fundamentality is opaque, using Sider's theory of structure as a motivating case study throughout. Two conceptions of fundamentality are distinguished, only one of which can explain why the vocabulary of fundamentality is opaque.

1 Introduction

Attitude ascriptions appear to be *opaque*: true identity sentences $a = b$ appear not to license truth-preserving substitution of a for b inside the scope of attitudinal vocabulary.[1] To take a familiar example, 'Clark Kent is Superman' and 'Lois believes that Superman can fly' both appear true, whereas 'Lois believes that Clark can fly' appears false. These appearances may of course be misleading and there is now a vast literature on the topic; I won't take a stand on that here. Irrespective of whether attitude ascriptions are in fact opaque, it is natural to think that *if* they're opaque, that's because they concern not just the entities represented by the terms within them, but also concern the manner in which those entities are represented. In our example, 'Lois believes that Superman can fly' partly concerns one way in which Lois mentally represents Superman/Kent—i.e. as a cape-wearing superhero—whereas 'Lois believes that Kent can fly' partly concerns a different way Lois mentally represents Superman/Kent—i.e. as a nerdy reporter. Because those ways differ, the sentences have different truth-conditions and so may have different truth-values too. In short, attitude ascriptions are opaque (if they're opaque) because they partly concern our ways of representing reality.

The idea generalises:

Only Representational Opacity Opacity arises only when truth is sensitive not just to what's represented but also to the way in which it's represented.

This hypothesis is plausible. To appreciate why, suppose '$a = b$' is true. Then the denotations d of 'a' and e of 'b' are numerically identical, just one single thing: there is absolutely no difference between d and e. Yet opacity requires a difference in truth-condition between a sentence $\phi(a)$ containing some occurrences of 'a' and another sentence $\phi(b)$ that differs only by replacing the displayed occurrences of 'a' with occurrences of 'b'. This difference cannot be due to a difference between the entity d/e provided by the terms 'a' and 'b' for the context $\phi(\ldots)$ to say something about. The only other candidate seems to

[1] I won't systematically differentiate use and mention, allowing context to disambiguate and using quotation only as necessary to avoid confusion.

be that the difference in truth-condition is due to a difference in how *d/e* is represented in $\phi(a)$ and $\phi(b)$. Opacity therefore arises only from vocabulary that is sensitive to how entities are represented.[2]

Given Only Representational Opacity, one would expect the core theoretical vocabulary of metaphysics to be *transparent*, i.e. not opaque. I mean the vocabulary of parthood, essence, ground, ontological categories, and fundamentality, for example. One central concern of metaphysics is with reality itself, independently of how we represent it. The vocabulary just mentioned plays two kinds of role in that enterprise. Firstly, it is used to formulate theories of what the reality underlying our representations is like. Secondly, it is used to delimit a central subject matter for metaphysical theorising. If the core theoretical vocabulary of metaphysics is opaque, it is difficult to see how it could play either role. Thus Cian Dorr (2016, p. 44) writes that "any operators we might need to appeal to in stating questions that are central to the subject matter of metaphysics should be transparent." .

Opacity in core metaphysical vocabulary also presents two additional obstacles to attractive metaphysical theorising.

Firstly, opacity in $\phi(\ldots)$ is an obstacle to the coherence of quantification into it, as in for example $\forall x \phi(x)$. If $\phi(\ldots)$ is opaque, semantic evaluation of $\phi(\alpha)$ depends on information about how the denotation of α is represented. Yet variables carry no information about how their values are represented. So when x and $\phi(\ldots)$ combine in $\phi(x)$, they may not properly interact under semantic evaluation, preventing assignment of a truth-condition to $\forall x \phi(x)$. For further discussion see (Quine 1961; Kaplan 1968; Kaplan 1986; Fine 1989). The problem this raises for opacity in the core theoretical vocabulary of metaphysics is that attractive theories will often contain generalisations involving that vocabulary, which typically requires quantification-in.

Secondly, even if quantification-in is coherent, classical quantificational logic cannot always preserve truth in the presence of opacity (Bacon and J. S. Russell 2019). To see why, consider this argument:

1. $\forall x \forall y \forall Z(x = y \to (Zx \leftrightarrow Zy))$
2. $\forall Z(a = b \to (Za \leftrightarrow Zb))$
3. $a = b \to \big((\lambda x.\phi(x))a \leftrightarrow (\lambda x.\phi(x))b\big)$
4. $a = b \to (\phi(a) \leftrightarrow \phi(b))$

The premise (1) is a classical (second-order) logical truth and the argument is valid in classical (second-order) logic. Yet the conclusion (4) is inconsistent with the corresponding instance of opacity in $\phi(\ldots)$:

$$a = b \wedge \phi(a) \wedge \neg\phi(b)$$

Classical quantificational reasoning therefore cannot always preserve truth, if there is opacity. Undesirable restrictions on universal instantiation or the rules governing complex predicates will be required. This complicates and weakens our ambient quantificational logic. It also limits our ability to record universal patterns in our theories as universal quantifications. The resulting theoretical package thereby becomes less attractive along the usual dimensions of theoretical evaluation, such as simplicity, strength, and elegance.

[2](Bacon and J. S. Russell 2019) develops a view that rejects Only Representational Opacity.

These problems, individually and collectively, are not fatal. But they do suggest that, all else being equal, opacity in the core theoretical vocabulary of metaphysics is best avoided.

All else may not be equal. Opacity in core metaphysical vocabulary may also bring theoretical benefits. Consider relative fundamentality for example. Opacity in relative fundamentality may enable us to reconcile a coarse-grained theory of propositional identity with a fine-grained theory of relative fundamentality.[3,4] To see what I mean, consider the following pairs:

There are exactly two cats	The number of cats is two
You're an aunt	You're a woman with a sibling who has a child
The rose is red	The rose instantiates *redness*
There is a cat	There are cat-wise arranged particles
Necessarily, $2+2=4$	It's true at every world that $2+2=4$

One side of each pair is naturally regarded as more fundamental than the other. Yet the members of each pair are necessarily equivalent. Assuming the following coarse-grained theory of propositional identity, the claims in each pair therefore express the same proposition:

Intensionalism Necessarily equivalent propositions are identical.

But if the claims in each pair express the same proposition, then it seems that one member cannot be more fundamental than the other. There is thus a tension between coarse-grained Intensionalism and the more fine-grained verdicts about relative fundamentality. How to alleviate this tension?

One can reject the fine-grained verdicts of relative fundamentality. Or one can reject the coarse-grained theory of propositional identity encoded in Intensionalism. Or one can permit propositions that are more fundamental than themselves. In case none of those appeals, opacity in relative fundamentality offers an alternative option by potentially enabling claims like the following all to be true:

$a=b$	For the rose to be red just is for the rose to instantiate *redness*
$\phi(a)$	It is more fundamental that the rose is red than that the rose instantiates *redness*
$\neg\phi(b)$	It is not more fundamental that the rose instantiates *redness* than that the rose instantiates *redness*

The attractions of coarse-grained Intensionalism and fine-grained relative fundamentality can perhaps thus be consistently combined.

Is the core theoretical vocabulary of metaphysics opaque? We've seen motivations for both positive and negative answers. My goal in this paper is to explore a positive answer for absolute fundamentality in particular. I focus on absolute fundamentality for two reasons. Firstly, because opacity in absolute fundamentality may seem especially puzzling: how could the way something is represented matter to whether it belongs to metaphysical bedrock? Secondly, because one prominent framework for theorising about absolute

[3] I use 'opacity in *F*' to abbreviate 'opacity in the vocabulary of *F*'. Likewise for similar phrases, for example '*F* is opaque' abbreviates 'the vocabulary of *F* is opaque'.

[4] I use informal talk of propositions, facts, properties, and relations to pronounce primitively interpreted quantification into sentence and predicate positions; see (Bacon 2024; Fritz and Jones 2024b; Goodman 2024).

fundamentality entails that absolute fundamentality is opaque, i.e. Theodore Sider's (2011) *Writing the Book of the World*. I begin by presenting this argument as concerns a particular example (§2). I then turn to identify the structural principles about fundamentality which underwrite the initial argument (§3).

Given this argument that fundamentality is opaque on Sider's view, I then ask why that is so. How can the way something is represented matter to whether it counts as fundamental? To answer, I distinguish two conceptions of fundamentality, which I call *generative* and *structural* (§4). I argue that fundamentality is not opaque under generative conceptions, whereas structural conceptions can readily explain why fundamentality is opaque; moreover, this explanation is compatible with Only Representational Opacity. The explanation deploys a postulated connection between fundamentality and metaphysically perspicuous representation, alongside the possibility of both perspicuous and non-perspicuous representations of the very same entity. In developing this explanation, I offer an account of the distinction between metaphysically perspicuous and non-perspicuous representations. To close my discussion of structural fundamentality, I consider how well it fits as an interpretation of Sider's view as well as its relationship to various other questions about fundamentality, including: Sider's epistemic role for fundamentality, the factivity of operators like 'it is fundamental that', and whether fundamentality itself is fundamental.

2 From Metaphysical Semantics to Opacity

My concern with opacity in fundamentality may seem overly speculative. Sure, in principle there are motivations for the view. But that's true of almost any view. Has any metaphysician ever seriously considered a view on which fundamentality is fact opaque? I argue in this section that they have.

Specifically, I argue from the view about fundamentality in Sider's (2011) *Writing the Book of the World* to the conclusion that fundamentality is opaque. I choose *Writing the Book of the World* because it is one of, if not the, most detailed, careful, systematic, and influential studies of fundamentality to date. I run the argument for a particular example in this section before seeking to identify the general principles underwriting the argument in the next section.

2.1 First Argument for Opacity in Fundamentality

Every theory of fundamentality requires level connectors. Somehow or other, the fundamental gives rise to the derivative. Level connectors are the relations between the fundamental and the derivative—more generally: between the more fundamental and the less fundamental—that provide the precise sense in which that is so.

The level connectors in *Writing the Book of the World* are provided by metaphysical semantics. This is a semantic theory whose role is to connect derivative sentences to their *fundamental truth-conditions*, i.e. the aspects of fundamental reality responsible for the truth or falsity of the sentence.

Metaphysical semantics has a limitation (Jones 2023). Because it is a semantic theory, it concerns only the relationship between linguistic items (or other representational entities) and the fundamental. Yet metaphysics concerns not only the relationship between derivative linguistic items and the fundamental; it also concerns the relationship between the phenomena those items represent and the fundamental. The semantic story provided by metaphysical semantics cannot be the whole story about level connectors because it concerns only derivative representations and not what they represent.

To illustrate, consider the derivative sentence 'there is a cat' and let C be a sentence expressing its fundamental truth-condition. Then the true metaphysical semantics will yield the following level connection:

(1) The fundamental truth-condition of 'there is a cat' is that C

Note that 'there is a cat' is mentioned here whereas C is used: the principle connects the sentence 'there is a cat' with whatever aspect of fundamental reality is expressed by C. But as well as mentioning 'there is a cat', we can also use it to truly say that there is at least one cat. How does the existence of at least one cat connect with fundamental reality? Because the existence of at least one cat is not at all a linguistic matter, this question is not addressed by (1). To express the relevant connection we need a sentence in which not just C but also 'there is a cat' is used rather than mentioned:

. . .there is a cat. . . C . . .

What level connecting vocabulary should replace the ellipses? What is the object language counterpart of assignments of fundamental truth-conditions to sentences?

One way to make progress is via the "biconditional" character of metaphysical semantics. Satisfaction of a derivative sentence's fundamental truth-condition is equivalent to the truth of that derivative sentence (Sider 2013a; Sider 2013b). Thus (1) entails:

(2) 'There is a cat' is true iff C

A sentence's truth should also be equivalent to satisfaction of the disquotational (as opposed to fundamental) truth-condition expressed just by using the sentence. Hence:

(3) 'There is a cat' is true iff there is a cat

Given (2) and (3), the fundamental and disquotational truth-conditions must also be equivalent. Thus:

(4) There is a cat iff C

We've seen that fundamental and disquotational truth-conditions are equivalent. Equivalent in what sense?

Well, it should be stronger than mere material equivalence.[5] In particular, it should be impossible for only one of the truth-conditions to be satisfied; for at such a possibility, 'there is a cat' both is and isn't true (in English). The 'iff' in (4) should therefore express necessary equivalence, i.e.:

(5) $\Box(\text{there is a cat} \leftrightarrow C)$

Generalising: the disquotational and fundamental truth-conditions of derivative sentences should be necessarily equivalent. Necessary in what sense?

[5] Sider (2011, note 9, p. 113) suggests that material equivalence will suffice for the 'iff' in (2). That doesn't naturally extend to (4). Sider's idea is that an explanatory semantic theory may assign (fundamental) truth-conditions by having material biconditionals like (2) as theorems. But (4) is not in the first instance part of a semantic theory. It concerns the relationship between truth-conditions themselves, not the parts of language that express them.

If Intensionalism is true, the modality used to state Intensionalism plays an especially central role in the metaphysics of propositions. That makes it a natural candidate for the necessity in the necessary equivalence of disquotational and fundamental truth-conditions. It then follows from Intensionalism—i.e. the thesis that necessarily equivalent propositions are identical (§1)—that the necessitated biconditional in (5) entails a corresponding identity, and hence that those truth-conditions are one and the same. More precisely, where $=$ is an identity predicate that takes formulas as arguments:[6]

(6) There is a cat $= C$

Informally: for there to be a cat just is for it to be that C. We'll also see below another argument for (6) that doesn't require Intensionalism (§2.2).

We now have an account of the level connection between there being a cat and the fundamental truth-condition that C: they're one and the same.[7] We also have a case of opacity, because by construction the following are true:

(7) It is not fundamental that there is a cat.

(8) It is fundamental that C.

(6), (7), and (8) together comprise a case of opacity in the operator 'it is fundamental that'. I next consider two kinds of response to this argument for opacity in fundamentality: rejection of (6) and rejection of (7) or (8).

2.2 Reject (6)?

One kind of response to the argument is to reject (6). I used Intensionalism to argue for (6), which might seem inappropriate in a discussion of Sider's view. Sider (2011, pp. 268–272) is a modal conventionalist, and so denies that there is an objective or theoretically privileged modality which could be used to state (5). However, my appeal to Intensionalism was just for presentational convenience. One can also argue for (6) from Sider's view that metaphysical semantics is the primary source of connections between levels, without appeal to Intensionalism or any other grain-theoretic assumptions.

We've seen two candidate kinds of level connection. On the one hand, metaphysical semantics associates derivative sentences with their fundamental truth-conditions, as in (1). On the other hand, fundamental-derivative identities such as (6) also hold. These two kinds of level connection do not have to compete. We can see them as mutually supporting components of a single structure. Yet if fundamental-derivative identities such as (6) fail, an additional level connector is required that genuinely competes with metaphysical semantics. This alternative level connector, not metaphysical semantics, is then the primary source of connections between levels.

Here's how metaphysical semantics and fundamental-derivative identities can be combined as mutually supporting components of a single structure. Our use of derivative

[6] More carefully, (6) follows from (5) together with the following regimentation of Intensionalism, where the identity sign $=$ takes formulas as arguments: $\forall p \forall q(\Box(p \leftrightarrow q) \rightarrow p = q)$. For more on this notion of identity, see (Dorr 2016; Rayo 2013).

[7] Sider (2011, p. 111) denies that certain formulas similar to (6) express level connections, for example 'the fact that there is a cat = the fact that C'. His argument specifically concerns the term-forming operator 'the fact that'. Because that operator does not occur in (6), Sider's argument does not also motivate denial that (6) expresses a level connection. The identity predicate in (6) connects formulas, not singular terms for facts.

language associates it with aspects of fundamental reality. Specifically, derivative sentences express fundamental truth-conditions. This provides us with two ways of expressing those fundamental truth-conditions. One can use the derivative sentence itself. Or one can use a fundamental sentence like *C*, one that uses only fundamental vocabulary to express the very same fundamental truth-condition. As a result, identity sentences like (6) are true, because our use of derivative language associates it with truth-conditions that can be expressed in more than one way, i.e. with derivative language and with fundamental language. Identity serves as a level connector on this view because we use ordinary derivative language to talk about and more generally represent aspects of fundamental reality, which we can also talk about and represent in more metaphysically perspicuous ways. (More on this notion of metaphysically perspicuous representation in §4.) Metaphysical semantics determines which derivative sentences express which fundamental truth-conditions, thereby also determining which fundamental-derivative identity sentences are true. Metaphysical semantics and fundamental-derivative identities thus provide complementary connections between levels on this view. Each language-reality connection provided by metaphysical semantics has a corresponding reality-reality connection provided by identity.[8]

By contrast, if fundamental-derivative identities like (6) do not hold, a level connector is required that genuinely competes with metaphysical semantics. For example, suppose the level connector is ground. I'll use $\Rightarrow$ as a grounding connective, with ground in the antecedent and grounded in the consequent. On this view we have:

There is a cat $\neq C$

(9) $C \Rightarrow$ there is a cat

The association of sentences with fundamental truth-conditions can now be factored into two components. One component uses ordinary linguistic semantics to associate sentences with disquotational (as opposed to fundamental) truth-conditions:

> The disquotational truth-condition of 'there is a cat' is that there is a cat.

The other component uses ground to connect these disquotational truth-conditions with fundamental reality, as in (9). [9] No distinctive role for metaphysical semantics remains. Its core theoretical role is to associate sentences with fundamental truth-conditions. Yet that role is filled by combining ordinary linguistic semantics with ground. Fundamental-derivative identities such as (6) are therefore motivated by Sider's view that metaphysical semantics is the primary source of level connections, not eliminable in favour of linguistic semantics plus another level connector such as ground.

[8] An analogous case. Because 'Superman' and 'Kent' both denote Clark, the identity sentence 'Superman = Kent' is true. Contrastingly, the identity fact that Superman = Kent doesn't hold because 'Superman' and 'Kent' both denote Clark: it's the very same fact as that Kent = Kent, which holds independently of what 'Superman' and 'Kent' denote. But that identity fact is expressible as 'Superman = Kent' because 'Superman' and 'Kent' denote Clark. The language-reality connection provided by denotation has a complementary reality-reality connection provided by identity.

[9] A complication arises because whereas metaphysical semantics is biconditional, ground is only conditional: the ground strictly implies the grounded but they're typically not strictly equivalent. This suggests that the fundamental truth-condition *C* will then also be grounded, presumably with different possible grounds at worlds where the existence of a cat is realized in different ways.

2.3 Reject (7) or (8)?

A different response to the argument for opacity in fundamentality is to reject (7) or (8). One unattractive version of this response endorses the negation of (7) or (8). That's unattractive because, applied in full generality, it trivialises the notion of fundamentality expressed by the sentential operator 'it is fundamental that'. A better option is to reject that operator as somehow defective.

Sider (2011, pp. 115–116, 128, 147–153) is sympathetic to this view. His official notion of fundamentality is *sub-propositional*: the fundamentality operator takes only sub-sentential vocabulary as arguments. By contrast, 'it is fundamental that' takes whole formulas as arguments. That sentential operator therefore does not really express fundamentality. At best, it expresses only a definitionally extended secondary notion of fundamentality. Opacity in the sentential operator does not then induce opacity in the vocabulary of fundamentality itself, i.e. in the vocabulary of sub-propositional fundamentality. Yet this isn't the end of the story for at least two reasons.

Firstly, an account is required of why the definitionally extended notion of fundamentality is opaque. Assuming Only Representational Opacity (p. 1), some vocabulary employed in the definition must be sensitive not just to what's represented but to the way in which it's represented. It is unclear how that could be under the most obvious candidate definitions. For example, one such candidate says that 'it is fundamental that' expresses the property of being a *structural truth*, i.e. a true proposition expressed by some sentence whose words all express fundamental sub-propositional notions (Sider 2011, p. 147). However, this will make the sentential operator transparent; for if a proposition is expressed by some such sentence, then so is any proposition identical to it.

Secondly, the epistemic role that Sider takes fundamentality to play, and which motivates him to adopt the notion, requires a propositional notion of fundamentality (Pickel 2017). Sider argues that theorising goes better when expressed in ways that better reflect the fundamental structure of reality: "wielders of non-joint-carving concepts are worse inquirers" (Sider 2011, p. 61). That explains why it's better to theorise with 'green' and 'blue' than with 'grue' and 'bleen'.[10] Yet this explanation requires a propositional notion of fundamentality.

To see why, consider a language L containing primitive predicates G for green and B for blue, and a language L_1 just like L except only that G expresses grue and B expresses bleen. Simplifying for convenience, suppose green and blue are fundamental whereas grue and bleen aren't. Sider's idea is that it's better to theorise in L than in L_1 because L better reflects the fundamental structure of the world. He aims to capture this difference between L and L_1 using sub-propositional fundamentality: G and B have fundamental meanings in L but not in L_1. However, there is another language L_2 such that (a) it's better to theorise in L than in L_2, (b) that difference arises for essentially the same reason as why it's better to theorise in L than in L_1, (c) sub-propositional fundamentality cannot explain that difference between L and L_2, and (d) propositional fundamentality can explain that difference between L and L_2.

To get a feel for L_2, consider a formula like 'a is G', where 'a' denotes o in both L and L_1. Recall that G expresses green in L and expresses grue in L_1. Standard semantic principles for the syntax of predication yield:

[10] *Definitions.* x is grue $:=$ x is green and observed before t, or x is blue and not observed before t. x is bleen $:=$ x is blue and observed before t, or x is green and not observed before t.

In L, 'a is G' means that o is green.

In L_1, 'a is G' means that o is grue.

Now, language L_2 agrees with L on the meanings of all primitive vocabulary. In particular, G expresses green and B expresses blue. So there are no sub-propositional differences in fundamentality between meanings in L and in L_2. However, the syntax of predication in L_2 is governed by a deviant semantic principle with the result that:

In L_2, 'a is G' means that o is grue.

For more detail about the semantics of L_2, see (Pickel 2017). It seems that L_2 is no better for theorising in than L_1, and that both do worse in this respect than L. Moreover, this difference from L has essentially the same source in each case: it's because 'a is G' means that o is grue in L_1 and L_2, but means that o is green in L. Since sub-propositional fundamentality doesn't differentiate L_2 from L_1, something else fundamentality-related must do so. The only apparent candidate is a propositional notion of fundamentality: 'a is G' has a fundamental meaning in L but not in L_1 or L_2. That is:

It's fundamental that o is green.

It's not fundamental that o is grue.

The lesson is that theorising can go wrong in just the way it goes wrong in L_1 without any departure from the good language L concerning the fundamentality of sub-sentential meanings. The shared defect in L_1 and L_2 concerns the meanings of whole formulas not just their parts. This requires a propositional notion of fundamentality and corresponding sentential operator.

Before moving on, it's interesting to note that this operator should be non-factive: if it's fundamental that p, it doesn't follow that p. That's because the meanings of sentences—and the epistemic value of theorising using those meanings—shouldn't vary between worlds just due to differences in how fundamental entities are configured at them. The meaning of 'a is G' should be fundamental in L but not in L_1 or L_2 irrespective of whether that sentence is true, of whether o is green, and of whether o is grue.

3 Underlying Principles

I've focussed so far on the relationship between a particular derivative fact—i.e. the fact that there is a cat—and the fundamental. The argument doesn't turn on any feature of that fact in particular: it generalises to any other derivative fact. I want now to construct a fully general version of the argument in order to isolate the underlying structural principles about fundamentality operative in Sider-style views.

I will formulate this argument in a higher-order language that permits quantification not just into singular term position but into (almost) every syntactic position. I will do so because the cases of opacity I'm discussing do not arise from substituting singular terms or any other sub-sentential vocabulary. They arise from substituting whole formulas directly. The identity predicate that occurs in these cases of opacity is one that takes formulas as arguments as in (6), not singular terms. Higher-order languages provide the simplest and clearest way to theorise about such matters (Dorr 2016; Skiba 2021; Fritz and Jones 2024a). So I first briefly outline the higher-order language I'll use (§3.1), before turning to the two main principles (§§3.2–3.3) driving the argument, and then to the argument itself (§3.4).

3.1 Formal Preliminaries

I'll use a language of simple relational type theory. Other kinds of higher-order language would suffice, but this one is about the simplest suited to present purposes. I'll be brief because many presentations of similar systems are available—for example, (Muskens 1989; Gallin 1975; Dorr 2016; Bacon 2023)—and the formal details are not my primary concern. The main difference from other presentations is that I omit λ and so treat the quantifiers as variable binders.

The language employs a system of syntactic categories or *types*: e (for singular terms), t (for formulas), $\langle \sigma_1 \ldots \sigma_n \rangle$ (with $n > 0$) whenever $\sigma_1 \ldots \sigma_n$ are types (for predicates that take n arguments of types $\sigma_1 \ldots \sigma_n$ respectively). Expressions of all types are called terms. Whenever F is a term of type $\langle \sigma_1 \ldots \sigma_n \rangle$ and $a_1 \ldots a_n$ are terms of types $\sigma_1 \ldots \sigma_n$ respectively, $Fa_1 \ldots a_n$ is a term of type t. For each type there are variables and may also be some constants. The usual logical connectives are included as typed constants, including in particular for each type σ an identity predicate $=_\sigma$ of type $\langle \sigma\sigma \rangle$; however, only the special case of $=_t$ which takes formulas as arguments will play a role below. I treat quantifiers as variable binders rather than typed constants. Variables of any type may be bound, which enables quantification into every type.

To aid readability, I use some standard notational conventions. ϕ and ψ are schematic letters for formulas (type t), while p and q are variables of type t. I use infix notation for the connectives and identity; so $p \wedge q$ is a stylistic variant of $\wedge pq$. I indicate types only when necessary. When types are not explicitly indicated, every way of assigning types permitted by the above is intended. I use upper-case for terms in predicate position where possible and freely insert brackets; so $X(y)$ is a stylistic variant of xy.

To enable theorising about fundamentality, we have for each type σ, a fundamentality predicate $\textsc{fund}_\sigma$ of type $\langle \sigma \rangle$ (so the subscript indicates the type of the argument). A fundamentality predication $\textsc{fund}_\sigma(a)$ formalizes the claim that the entity a (of type σ) is fundamental. This is a departure from Sider (2011), who has a single fundamentality operator that can take any term as argument. Nothing substantive turns on this difference. The typed fundamentality constants simply allow us to treat fundamentality predications syntactically like all other predications. If you believe in a univocal notion of fundamentality applicable to entities of all types, think of the typed fundamentality constants as expressing it, yet subject to merely syntactic restrictions on what each can be used to attribute fundamentality to.

I will often want to write long conjunctions of fundamentality attributions: $\textsc{fund}(F) \wedge \textsc{fund}(a_1) \wedge \ldots \wedge \textsc{fund}(a_n)$. Because this is cumbersome, I abbreviate it as $\textsc{fund}(F, a_1, \ldots, a_n)$. Note the use of commas to differentiate (a) this abbreviation of a conjunction of fundamentality attributions from (b) a single fundamentality attribution with a formula as argument, $\textsc{fund}(Fa_1 \ldots a_n)$.

3.2 Closure

Our first goal is a suitable generalisation of (8):

(8) It is fundamental that C.

Recall that C captures the configuration of fundamental entities that accounts for there being a cat. Let's assume that this configuration is an instantiation of a fundamental property by fundamental arguments;[11] I return to this assumption at the end of the next section. The simplest generalisation of (8) thus says that every instantiation of a fundamental property by fundamental arguments is itself fundamental:

Closure $\forall X \forall y_1 \ldots \forall y_n \big((\textsc{fund}(X, y_1, \ldots, y_n) \wedge X y_1 \ldots y_n) \rightarrow \textsc{fund}(X y_1 \ldots y_n) \big)$ (for every n)

Informally, this says that fundamentality is closed under instantiation: instantiations of fundamental properties by fundamental arguments are fundamental facts.

Closure is a substantive and perhaps surprising principle. We can argue for it in at least two ways.

Firstly, we saw (§2.3) that Sider's epistemic role for fundamentality requires a distinction between the fundamental and deviant ways of combining fundamental entities. To say that fundamental entities have been combined in a fundamental way, we attribute fundamentality to the result of so combining them (not merely to the entities combined). I assume that the fundamental way of combining properties with arguments is via application and expressed by the syntax of predication in our chosen higher-order language. A sentential operator of fundamentality should therefore apply to every application of fundamental properties to fundamental arguments, which verifies Closure.

Secondly, Closure can be motivated via Sider's metaphor of joint-carving. The idea behind the metaphor is that reality's fundamental structure delineates the underlying joints between its constituents. Although there is a distinction between grue things and bleen things, that's an artificial division not an underlying joint, and is thus not fundamental. So now suppose that a formula ϕ is composed from joint-carving vocabulary combined in a joint-carving way. Then ϕ expresses its meaning in a joint-carving way too. It should therefore be joint-carving, and hence fundamental, that ϕ, which verifies Closure. I discuss joint-carving in slightly more detail later (§4.2).

3.3 Completeness

Our next goal is a generalisation of the derivative-fundamental identity (6):

(6) There is a cat $= C$

Recall that C here captures the configuration of fundamental entities that accounts for there being a cat. Continuing with our assumption that this is an application of a fundamental property to fundamental arguments, the general principle operative here is:

Completeness (informal) Every derivative fact is identical to an application of a fundamental property to fundamental arguments.

In other words, propositional identity is the level connecting relation between derivative facts and fundamental reality.[12] Assuming that every fundamental fact is already an application of a fundamental property to fundamental arguments, the initial restriction to derivative facts is superfluous and so I ignore it henceforth.

[11] I count relations of all arities as properties for simplicity.

[12] Completeness (informal) is closely related to Sider's official principle of "Completeness (new version)[:] Every sentence that contains expressions that do not carve at the joints has a metaphysical semantics" (Sider 2011, p. 116). We can argue from Sider's Completeness (new version) to Completeness (informal) as follows. Suppose it's a derivative fact that ϕ. Then the sentence 'ϕ' I just used for that fact presumably contains expressions (or syntax more generally) for entities that are not fundamental. Those constituents of 'ϕ' do not carve at the joints. So by Completeness (new version), 'ϕ' has a metaphysical semantics

It's not straightforward to formalise Completeness (informal). The problem is that different derivative facts may be identical to instantiations of fundamental properties by different numbers and types of fundamental arguments. That's not permitted by a straightforward formalisation like:

$$\forall p\Big(p \rightarrow \exists X \exists y_1 \ldots \exists y_n\big(\textsc{fund}(X, y_1, \ldots, y_n) \wedge p = Xy_1 \ldots y_n\big)\Big)$$

To endorse this claim, we need to make a choice about the value of n and the type of each of $X, y_1, \ldots, y_n$. The resulting principle is too strong because it doesn't permit variation across derivative facts in the types and number of fundamental arguments.

I have a partial solution to this problem. Although I can't see how to capture the full intuitive content of Completeness (informal) using the present resources, we can capture a clear consequence thereof.[13] That consequence will suffice for my argument.

I'll formalise Completeness as a constraint on theories of a certain sort. A theory in this sense is a set of sentences of our formal higher-order language. I focus on *fundamentality theories*, i.e. theories intended to capture the relationship between the derivative phenomena expressible in the language and the fundamental. Note that fundamentality theories are only intended to express truths, not truths with some further special status, such as logical or necessary truth. To say that a sentence ϕ is a member of fundamentality theory T, I write $\vdash_T \phi$; and $\Gamma \vdash_T \phi$ to say that if every member of Γ belongs to T then so does ϕ. I will mostly normally leave T implicit.

We can now formalise Completeness (informal) schematically thus:

Completeness If $\vdash \phi$, then for some n and some types $\sigma_1 \ldots \sigma_n$, $\vdash \exists X \exists y_1 \ldots \exists y_n\big(\textsc{fund}(X, y_1, \ldots, y_n) \wedge \phi = Xy_1 \ldots y_n\big)$, where X has type $\langle \sigma_1 \ldots \sigma_n \rangle$ and each y_i has type σ_i.

Informally, Completeness says that if it's a fact that ϕ according to a fundamentality theory, then the theory also says that this fact is identical to some instantiation of a fundamental property by fundamental arguments. Because the quantification on n and over types occurs outside the theory, in our language for describing fundamentality theories, their values can vary for different substitutions for ϕ. The cost of this flexibility is that Completeness is weaker than its informal counterpart in the way that schemas generally are weaker than universal quantifications. Specifically, Completeness concerns only facts expressed by formulas of the formal language, not every fact whatsoever. This limitation won't affect my argument below.

One problem for Completeness arises from multiple realizability. There's more than one way for there to be a cat. Certain specific particles could be arranged in a certain fully specific configuration. But those same particles could instead be in a slightly different fully specific configuration; or different particles could be in one of those configurations. The existence of a cat therefore cannot be identical to any one of these potential realizing facts.

associating it with a fundamental truth-condition: the fundamental truth-condition of 'ϕ' is that ψ. By the account of fundamental truth-conditions I argued for in §2.2, $\phi =_t \psi$. Assuming that the fundamental truth-condition that ψ is an application of a fundamental property to fundamental arguments, this verifies Completeness (informal).

[13] (Wilhelm forthcoming) advocates for a richer kind of higher-order language, which potentially could express the full intuitive content of Completeness (informal). I stick with more widely employed resources here for simplicity.

Worse still, the realizing facts I just mentioned do not appear to be applications of fundamental properties to fundamental arguments. Even if the particles and their properties are fundamental, the specific "cat-wise" ways of configuring the particles are not fundamental properties. Rather, they're distributions of many fundamental properties over the particles, not applications of a single fundamental property to them.

Both problems can perhaps be solved, if the logical operators are fundamental. That view is well-motivated in the present context for two reasons. Firstly, because we're interested in Completeness as a candidate principle governing fundamentality in Sider-style views, and Sider (2011, ch. 9) argues that the logical operators are fundamental. Secondly, because I argue below (§4.3) that the logical operators are fundamental under what I'll call a structural conception of fundamentality (§4.2), and that conception is required to explain why fundamentality is opaque, as Completeness and Closure imply.

Here's how the solution goes. Each specific distribution of fundamental properties over specific particles can be obtained by conjoining applications of fundamental properties to particles. If Closure holds, then each conjunct is itself fundamental. And if the conjunction relation is fundamental, the resulting conjunction as a whole will also be fundamental. This ensures that each specific realizing distribution of fundamental properties over fundamental particles is fundamental. Every possible such distribution can then be disjoined into a fact necessarily equivalent to there being a cat. If Closure holds and the disjunction relation is fundamental, then the resulting disjunction of possible realizers will itself be an application of a fundamental property (i.e. disjunction) to fundamental arguments (i.e. the possible realizing distributions). For further discussion of multiple realizability and related problems for Sider's view more generally, see (Schaffer 2013; Sider 2013b; deRosset 2023).

One final, related worry about Completeness is that it implausibly restricts the fundamental base, even assuming Sider's view.[14] Maybe the existence of a cat needn't be identified with a single application of a single fundamental property. It might instead be identified with a plurality of applications of fundamental properties to arguments. However, it's difficult to make precise sense of this proposal. It identifies a single proposition with a plurality thereof. This requires a propositional analogue of the cross-type singular-plural identity relation employed by (strong forms of) the mereological thesis of composition as identity, i.e. the thesis that each composite individual is identical to the plurality of mereological simples that compose it. Now, the (putative) cross-type singular-plural identity relation for individuals is notoriously difficult to make sense of. It's no easier to make sense of a cross-type singular-plural propositional identity relation. Rather than trying to settle the issue here, I'll just set this interesting proposal aside and move on; for more on composition as identity see (Lewis 1991, pp. 81–87; Wallace 2011a; Wallace 2011b; Cotnoir and Baxter 2014).

3.4 Second Argument for Opacity in Fundamentality

Given any fact that is not fundamental, Completeness and Closure entail that fundamentality is opaque. I'll continue to use as an arbitrary example the fact that there is a cat. Informally, the argument proceeds as follows. It's a derivative fact that there is a cat. By Completeness, that fact is identical to an instantiation of a fundamental property by fundamental arguments. By Closure, that instantiation of a fundamental property by

[14]Thanks to an anonymous reviewer for this suggestion.

fundamental arguments is itself fundamental. But then it's a fundamental fact identical to the derivative, hence not fundamental, fact that there is a cat. This is an instance of opacity in fundamentality.

To formalize this reasoning in our higher-order language, we first need to be able to express in the language that there is a cat. I'll use CAT as a sentence letter (constant of type t) formalizing 'there is a cat'. The claim that it's a derivative fact that there is a cat is then formalized thus:

$$\textsc{cat} \wedge \neg\textsc{fund}(\textsc{cat})$$

We will also need some principles about fundamentality theories. Specifically, some standard principles for the logical operators and propositional identity:

PL $\vdash \phi$ whenever ϕ is a substitution instance of a theorem of classical propositional logic.

MP If $\vdash \phi$ and $\vdash \phi \to \psi$, then $\vdash \psi$.

UI $\vdash \forall v\phi \to \phi[a/v]$

EG $\vdash \phi[a/v] \to \exists v\phi$

UG If $\vdash \phi \to \psi$, then $\vdash \phi \to \forall v\psi$ (provided v is not free in ϕ).

Inst If $\vdash \phi \to \psi$, then $\vdash \exists v\phi \to \psi$ (provided v is not free in ψ).

Material Equivalence $\forall p \forall q(p = q \to (p \leftrightarrow q))$

Although the argument won't require UG, I include it here for completeness.

The logic of identity assumed here is very weak. In effect, we assume only that identical propositions have the same truth-value. We cannot derive using these resources alone that identical entities have the same properties, or that any non-logical vocabulary (including FUND) is transparent.

We can now formalize the argument. We'll reason in our informal language about what sentences belong to an arbitrary fundamentality theory T, starting from the assumption that T says it's a derivative fact that there is a cat. Each line of the derivation should be understood as claiming that T contains the formula on that line; i.e. each line is implicitly prefixed with $\vdash$. Here's the argument:

1. $\textsc{cat} \wedge \neg\textsc{fund}(\textsc{cat})$
2. 1, Completeness: (for some n) $\exists X \exists y_1 \ldots \exists y_n(\textsc{fund}(X, y_1, \ldots y_n) \wedge \textsc{cat} = Xy_1 \ldots y_n)$
3. Suppose: $\textsc{fund}(X, y_1, \ldots, y_n) \wedge \textsc{cat} = Xy_1 \ldots y_n$
4. Material Equivalence, UI, PL: $(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{cat}) \to Xy_1 \ldots y_n$
5. 1, 3, 4, PL, MP: $Xy_1 \ldots y_n$
6. 3, 5, PL: $\textsc{fund}(X, y_1 \ldots y_n) \wedge Xy_1 \ldots y_n$
7. 6, Closure, UI, MP: $\textsc{fund}(Xy_1 \ldots y_n)$
8. 1, 3, 7, PL: $\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat})$
9. 8, EG: (for some n) $\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

10. 9, PL, discharging 3: $(\textsc{fund}(X, y_1, \ldots, y_n) \wedge \textsc{cat} = Xy_1 \ldots y_n) \rightarrow$
$\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

11. 10, Inst: $\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(X, y_1, \ldots, y_n)) \rightarrow$
$\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

12. 2, 11, MP: $\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

Line 1 formalizes the claim that it's a derivative fact that there is a cat. At line 12 we've derived that there is opacity in the fundamentality sentential operator FUND. Given Completeness, Closure, our background logic, and any derivative fact, it follows that fundamentality is opaque.

This argument can be simplified slightly. My initial informal presentation concerned facts, and I formalized 'the fact that ϕ' as just ϕ. Closure and Completeness were formulated with corresponding restrictions to facts. As a result, Material Equivalence was required (at 4) to ensure that since (by 1 and 3) $\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{cat}$, then also (at 5) $Xy_1 \ldots y_n$. The argument can be simplified by dropping the restriction to facts in Closure and Completeness. The resulting principles concern all propositions, not just those which happen also to be facts. As a result, we no longer require Material Equivalence or any principle specifically about identity except for Closure and Completeness.

The simplified versions of Closure and Completeness are:

Closure* $\forall X \forall y_1 \ldots \forall y_n((\textsc{fund}(X, y_1, \ldots y_n)) \rightarrow \textsc{fund}(Xy_1 \ldots y_n))$[15]

(Informally: fundamentality is closed under application (as opposed to instantiation); applications of fundamental properties to fundamental arguments are fundamental propositions.)

Completeness* For each formula ϕ there is some n and some types $\sigma_1 \ldots \sigma_n$ such that $\vdash \exists X \exists y_1 \ldots \exists y_n(\textsc{fund}(X, y_1, \ldots, y_n) \wedge \phi = Xy_1 \ldots y_n)$, where X has type $\langle \sigma_1 \ldots \sigma_n \rangle$ and each y_i has type σ_i.

(Informally: every proposition is identical to some application of a fundamental property to fundamental arguments.)

The simplified argument proceeds much as before, except without needing to invoke Material Equivalence. More precisely:

1*. $\neg\textsc{fund}(\textsc{cat})$

2*. Completeness*: (for some n) $\exists X \exists y_1 \ldots \exists y_n(\textsc{fund}(X, y_1, \ldots, y_n) \wedge \textsc{cat} = Xy_1 \ldots y_n)$

3*. Suppose: $\textsc{fund}(X, y_1, \ldots, y_n) \wedge \textsc{cat} = Xy_1 \ldots y_n$

4*. Closure*, UI: $\textsc{fund}(X, y_1, \ldots, y_n) \rightarrow \textsc{fund}(Xy_1 \ldots y_n)$

5*. 3*, 4*, MP: $\textsc{fund}(Xy_1 \ldots y_n)$

6*. 1*, 3*, 5*, PL: $\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat})$

7*. 6*, EG: $\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

[15] Note that Closure* requires a non-factive fundamentality operator. I argued in §2.3 that Sider's epistemic role for fundamentality naturally leads to such a non-factive operator.

8*. 7*, PL, discharging 3*: $(\textsc{fund}(X, y_1, \ldots, y_n) \wedge \textsc{cat} = Xy_1 \ldots y_n) \to$
$\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

9*. 8*, Inst: $\exists X \exists y_1 \ldots \exists y_n(\textsc{fund}(X, y_1, \ldots, y_n) \wedge \textsc{cat} = Xy_1 \ldots y_n) \to$
$\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

10*. 2*, 9*, MP: $\exists X \exists y_1 \ldots \exists y_n(\textsc{cat} = Xy_1 \ldots y_n \wedge \textsc{fund}(Xy_1 \ldots y_n) \wedge \neg\textsc{fund}(\textsc{cat}))$

As before, we've derived from an arbitrary example of a derivative proposition (at 1*) that there is opacity in the fundamentality sentential operator. The derivation used relatively minimal logical resources. In particular, the only principles specifically about identity are Closure* and Completeness*.

I find it illuminating to have both versions of the argument available. The starred version allows us to identify Completeness and Closure as the source of opacity, rather than any other principle specifically about identity. However, some may regard the higher-order formalization as misleading, and think it should be more perspicuously recast using only first-order quantification over individuals that are facts, propositions, and properties. A natural supplement to this first-orderising view holds that there are no "false" or "unobtaining" states of affairs or propositions; this was Bertrand Russell's (1912, ch. 12) view for example. Completeness* and Closure* might then be rejected. The unstarred argument shows, however, that opacity in fundamentality follows nonetheless from the weaker unstarred principles together with Material Equivalence.

One natural reaction to these arguments is that they show Closure and Completeness to be jointly unstable. Although individually plausible, they cannot be coherently combined. Closure says (roughly) that decomposability into fundamentalia suffices for fundamentality, and Completeness says (roughly) that every fact decomposes into fundamentalia. When combined, it follows that every fact is identical to a fundamental fact. Since it's a non-fundamental fact that there is a cat, at least one of Closure and Completeness therefore has to go.

This reaction is plausible but not mandatory. I want to explore a different option. The final step in the preceding reasoning implicitly assumes that fundamentality is transparent. Even if every fact is identical to a fundamental fact, it doesn't follow without further assumptions that it's fundamental that there is a cat. *If* the vocabulary of fundamentality is opaque, the fact there is a cat may be identical to the fact that *C*, even though it's fundamental that *C* and not fundamental that there is a cat. Yet how could the vocabulary of fundamentality be opaque? How exactly is it sensitive to the way in which entities are represented? The next section distinguishes between two conceptions of fundamentality in order to answer these questions.

4 Two Conceptions of Fundamentality

We can disentangle two broad conceptions of fundamentality, and of metaphysical structure more generally, operative in contemporary metaphysics. I call them the *generative* and *structural* conceptions; see also (Williams 2010; Williams 2012; Solodkoff and Woodward 2013; Fine 2013; Jones 2023; Frugé 2024; Rubenstein 2024; Wilson forthcoming). I'll argue that generative fundamentality does not give rise to opacity (§4.1), whereas structural fundamentality does (§4.2). Importantly, opacity in the vocabulary of structural fundamentality can be explained in a manner compatible with Only Representational Opacity

(§1) by articulating precisely how that vocabulary is sensitive to the way entities are represented. I close by discussing some further differences between the two conceptions and the extent to which structural fundamentality fits with Sider's view (§4.3).

It's worth noting before getting into details that these two conceptions are not in competition. There may be theoretical work for both structural and generative fundamentality (Frugé 2024; Rubenstein 2024).

4.1 Generative Fundamentality

The paradigm example of a generative conception of fundamentality comes from the literature on ground (Schaffer 2009; Rosen 2010; Fine 2012; Bennett 2017). On this conception, some entities generate others in a metaphysically robust sense. There is an operation (or some operations) that takes entities as input and generates further entities as output. Generated entities exist and are (to a significant extent) the way they are because they are the outputs of their generating operations for such-and-such inputs. Generated entities are in some sense constituted by their generators, but they are nonetheless different entities.

Reality exhibits a hierarchical generation structure on this conception. The fundamental entities are the base of this structure. They're ultimately responsible for generating all else, by being inputs and not outputs of the generative operations. The derivative entities comprise the rest of the structure, the generated entities. The fundamental/derivative distinction is thus a distinction between entities, constituents of reality itself. Whether an entity is an input or output of a generative operation is independent of how it's represented.[16] So generative fundamentality is also independent of how entities are represented. Assuming Only Representational Opacity (p.1), generative fundamentality is therefore not opaque.

Correspondingly, both arguments for opacity in fundamentality are unsound under generative conceptions. Generated entities are genuinely new, distinct from what generates them. Fundamental-derivative identities such as (6) are therefore false, rendering the first argument (§2.1) unsound. The second argument (§3.4) is unsound because Completeness is false: derivative facts are generated by, and hence distinct from, applications of fundamental properties to fundamental arguments.

4.2 Structural Fundamentality

The structural conception of fundamentality begins from the observation that some entities have many different decompositions into constituents. For example, I decompose into (a) a top half and a bottom half; (b) a left hand, a right hand, and all the rest of me; (c) various biological systems (skeletal, nervous, circulatory etc.). These decompositions are not all equal; some are privileged over others. My decompositions (a) and (b) are relatively superficial. They provide little information about my underlying nature and play little role in explaining my behaviour. Decomposition (c) does better. It provides substantive information about what kind of thing I am and how I interact with other things. One might even postulate a maximally privileged decomposition of me, providing a maximally

[16] For a contrasting view, see (Correia 2017; Fine 2017) on representational or conceptual ground. It is unclear to me how best to understand those notions.

informative explanation of what kind of thing I am and why I interact with other things as I do.

The structural conception of fundamentality extends this idea from concrete individuals to other entities, including properties and propositions. I'll focus on propositions, although my discussion is intended to generalise.

The idea is that a single proposition may have many decompositions into constituents. For example, the proposition that Romeo loves Juliet might decompose into the constituents (a) *loves*, Romeo, and Juliet; (b) *loves Juliet*, and Romeo; and (c) *Romeo loves* and Juliet. However, these decompositions are not all equal; some are privileged over others. For example, let's speculatively assume, decompositions (b) and (c) are relatively superficial, they don't carve the proposition along its underlying joints. By contrast, decomposition (a) goes deeper: it captures the proposition's underlying relational nature and thereby explains why it exists and other central facts about it. The *deep structure* of a proposition is a decomposition of it that is maximally privileged in this way.[17]

Different sentences expressing a proposition may capture different decompositions of it. A sentence captures a decomposition by having simple syntactic constituents that denote the constituents according to the decomposition. When a sentence captures a decomposition that is the deep structure of the proposition it expresses, the sentence is a *structurally fundamental representation* of that proposition; other representations of the proposition are *structurally superficial*. For example, continuing with the above example, suppose that simple predicate F expresses *loves Juliet* and a denotes Romeo. The sentence Fa then captures decomposition (b) above of the proposition that Romeo loves Juliet. So that sentence is a structurally superficial representation of the proposition because, we speculatively assumed, decomposition (b) is not its deep structure. Now suppose that simple predicate R expresses *love*, a denotes Romeo, and b denotes Juliet. The sentence Rab then captures decomposition (a) above of the proposition that Romeo loves Juliet. So that sentence is a structurally fundamental representation of the proposition, given our earlier assumption that decomposition (a) is its deep structure.

One goal of metaphysical theorising is to develop a metaphysically perspicuous language for theorising about a given topic. We can understand this as a language that permits structurally fundamental representations. If our language of metaphysical theorising contained only structurally fundamental representations, there would be no role for (structural) fundamentality operators in it. But when the language contains both structurally fundamental and superficial representations, it may be useful to differentiate them within our theories themselves. That's where fundamentality operators come in, supplied with the following truth-condition:

> 'a is fundamental' is true just in case 'a' is a structurally fundamental representation of its denotation.

This truth-condition enables 'fundamental' to differentiate between fundamental and superficial representations of an entity without metalinguistic ascent outside one's language of metaphysical theorising. It also induces opacity because there may be terms 'a' and

[17] I'm simplifying in two ways. Firstly, a decomposition should specify not just a list of constituents but also a way of combining those constituents; for different ways of combining the same constituents may yield different propositions. Secondly, the discussion in §2.3 shows that we should distinguish between superficial and deep, or privileged, ways of combining entities. I'll ignore these issues in the main text to simplify exposition.

'*b*' denoting the same entity *e*, only one of which captures the deep structure of *e* in its syntactic structure and thereby provides a structurally fundamental representation of *e*. Suppose the structurally fundamental term is '*a*' and the structurally superficial term is '*b*'. Then '*a* is fundamental' is true and '*b* is fundamental' is false, even though '$a = b$' is true because '*a*' and '*b*' co-denote *e*. For another, slightly more concrete, example consider again the proposition that Romeo loves Juliet. According to our earlier hypotheses about that proposition's deep structure:

> 'It's fundamental that *Rab*' is true because (i) '*R*' denotes *love*, '*a*' denotes Romeo, and '*b*' denotes Juliet, and (ii) the decomposition into *love*, Romeo, and Juliet is the deep structure of the proposition that Romeo loves Juliet.
>
> 'It's fundamental that *Fa*' is false because (i) '*F*' denotes *loves Juliet* and '*a*' denotes Romeo, and (ii) the decomposition into *loves Juliet* and Romeo is a superficial decomposition of the proposition that Romeo loves Juliet.
>
> 'For it to be that *Rab* just is for it to be that *Fa*' is true because '*Rab*' and '*Fa*' co-express the proposition that Romeo loves Juliet.

Structural conceptions of fundamentality can thus explain why the vocabulary of fundamentality is opaque. Moreover, the explanation is fully compatible with Only Representational Opacity: structural fundamentality operators are opaque because they're sensitive to whether entities are denoted in structurally fundamental ways, i.e. by terms whose syntactic structure captures the deep structure of their denotations.

Sider's discussion suggests an optional extension of this core picture. According to this view, there is a relatively small collection of entities, which I will call *joints*. The joints have two distinctive features. Firstly, the only constituents of any deep structure are joints. Secondly, every decomposition of an entity into joints is a deep structure of that entity, and so any term whose simple constituents all denote joints is a structurally fundamental representation of its denotation; call this the *joint carving thesis*.

One attraction of the joint carving thesis is that it offers a reductive definition of deep structure in terms of joint. This differentiates joint from fundamentality because deep structure, and hence also joint, is a transparent notion used to explain why fundamentality is opaque. The truth of '*a* is a joint' depends only on the denotation of '*a*', not on what kind of term is used to denote it, unlike the truth of '*a* is fundamental'. On the other hand, the joint-carving thesis will make deep structure non-unique, if entities are multiply definable from joints.[18] So although the joint carving thesis is interesting, it raises too many issues to address here. I therefore won't discuss it further, other than to repeat now that it's a optional supplement to the core structural fundamentality view.

We saw that the two arguments for opacity in fundamentality are unsound under the generative conception of fundamentality. How do they fare under the structural conception?

The first argument is sound under the structural conception of fundamentality. Recall the key premises of that argument (§2.1):

(6) There is a cat $= C$.

[18] For example, if negation is a joint and $p =_t \neg\neg p$, then the joint carving theses implies that every proposition *p* has negation as a constituent under some deep structure. Since many propositions presumably also have negation-free deep structures, it follows that deep structure is non-unique.

(7) It is not fundamental that there is a cat.

(8) It is fundamental that C.

(6) holds because 'there is a cat' and 'C' both express the same proposition p. (7) is true because 'there is a cat' is structurally superfificial representation of p: 'cat' is a simple term for a metaphysically complex phenomenon. And (8) is true because 'C' is (we can assume) a structurally fundamental representation of p: the deep structure of p is a decomposition whose constituents are the denotations of the simple syntactic constituents of 'C'.

The second argument for opacity in fundamentality is more difficult to evaluate. Completeness and Closure both quantify into the scope of FUND. Yet my account of structural fundamentality operators makes no provision for such quantification-in. Absent a specific semantic proposal about quantification into the scope of FUND, one should therefore be agnostic about Completeness and Closure under structural conceptions of fundamentality. I won't offer any such proposal. I'll argue instead that structural conceptions verify related principles which suffice for a version of the second argument for opacity in fundamentality.

The replacements for Closure and Completeness are schematic principles that capture their instantiations:

Closure⁺ $\big(\textsc{fund}(F, a_1, \ldots, a_n) \wedge Fa_1 \ldots a_n\big) \rightarrow \textsc{fund}(Fa_1 \ldots a_n)$ (whenever F and $a_1 \ldots a_n$ are closed terms)

Completeness⁺ If $\vdash \phi$, then for some n and some constants $a_1, \ldots, a_n$, and F of some types $\sigma_1, \ldots, \sigma_n$, and $\langle \sigma_1 \ldots \sigma_n \rangle$ respectively $\vdash \textsc{fund}(F, a_1, \ldots, a_n) \wedge \phi = Fa_1 \ldots a_n$

I'll discuss these principles in turn.

We can argue for Closure⁺ under the structural conception as follows. A metaphysically perspicuous representation of an entity should result from taking metaphysically perspicuous representations of its constituents (under some decomposition) and then combining them in a metaphysically perspicuous way. The antecedent of Closure⁺ ensures that the terms F and $a_1 \ldots a_n$ are metaphysically perspicuous representations of their denotations. The consequent of Closure⁺ combines those representations using the syntax of predication. So Closure⁺ follows from the thesis that the syntax of predication is metaphysically perspicuous: property application is a non-deviant way of combining entities into facts and propositions.

Turning now to Completeness⁺, it's false in many languages because they don't contain terms for the constituents of the deep structure of each truth expressible in the language. But there is no problem in principle for extending any language with new constants for those entities. So provided each true proposition has some deep structure, there is no problem in principle for extending any given language into a language in which Completeness⁺ holds. I cannot say exactly what terms that language will contain, since that would require substantive metaphysical investigation of the relevant deep structures. But that is no obstacle to the existence of such a language.

I've argued that the structural conception of fundamentality supports the existence of languages for which Closure⁺ and Completeness⁺ both hold. The second argument for opacity can be recast in such a language, replacing Closure and Completeness with these new variant principles. Since the differences between the arguments are relatively trivial, I won't present the revised argument here.

One might respond that, due to reliance on Completeness$^+$, the revised argument shows only that the vocabulary of fundamentality is opaque in certain speculative languages we don't currently understand and probably never will. However, problems don't go away just because one's language cannot express them. Languages that verify Completeness$^+$ differ from higher-order languages we do understand only by including new constants. There is nothing intrinsically problematic about those constants. And the inclusion of new constants doesn't change the denotations of pre-existing vocabulary. So the underlying mechanism responsible for opacity in languages that verify Completeness$^+$ is already present in languages that don't, because Completeness$^+$ would hold were the language suitably enriched. Compare: the problems raised by apparent opacity in attitudinal vocabulary would still arise even if it turned out that no speakers happened ever to have used distinct co-denoting names.

We've seen clear differences between the generative and structural conceptions of fundamentality. The generative conception will reject opacity in fundamentality, Completeness, and fundamental-derivative identities. By contrast, the structural conception of fundamentality can explain opacity in fundamentality in a manner compatible with Only Representational Opacity, and will verify certain fundamental-derivative identities as well as the existence of languages in which a version of Completeness (i.e. Completeness$^+$) holds.

4.3 Compare and Contrast

I want now to look at two further differences between structural and generative fundamentality, concerning the epistemic role of fundamentality and the logical operators. I'll then discuss the relationship between structural fundamentality and Sider's view, arguing that structural fundamentality is a good but not perfect for Sider's view. I won't try to resolve this mismatch.

I argued in §2.3 that Sider's epistemic role for fundamentality requires a propositional notion of fundamentality and corresponding sentential operator. This epistemic role fits well with the structural but not generative conception. Although there isn't a direct argument from the structural conception to the epistemic role, it is at least intelligible why theorising in more metaphysically perspicuous terms is better than theorising in less metaphysically perspicuous terms. By contrast, theorising only about the base of the generation hierarchy is often not of epistemic value; for legitimate theoretical interests often concern generated aspects of reality, as in for example chemistry, biology, the social sciences, aesthetics, or ethics.

Relatedly, I argued in §2.3 that the sentential operator associated with Sider's epistemic role should be non-factive. This fits well with structural fundamentality because a proposition's deep structure should be independent of whether it's the case.

Another difference between the two conceptions concerns the logical operators. Generative conceptions will tend not to treat conjunction, disjunction, and universal and existential quantification as fundamental, because facts involving those notions can be generated from other facts. (Matters are less clear for negation.) For example, the disjunctive fact that $p \vee q$ can be generated from the fact that p or from the fact that q, whichever is the case; the fact that something is F can be generated from any witnessing fact that such-and-such particular entity is F.

By contrast, structural conceptions face pressure to sometimes include logical operators in the deep structures. To see why, consider again the disjunctive fact that $p \vee q$. Since $p \vee q$ is not identical to p and not identical to q, neither potential generator p nor q alone enables a metaphysically perspicuous representation of $p \vee q$ itself. The deep structure for $p \vee q$ needs to specify how that proposition is constructed from simpler constituents, independently of which disjunct happens to be the case. Most obviously, it's constructed by applying the disjunction relation to p and q; in which case the disjunction relation is included in its deep structure. I earlier appealed to the fundamentality of logical operators to reconcile Completeness with multiple realizability (§3.3). I've just argued, in effect, that there are independent reasons internal to structural conceptions of fundamentality to endorse that view.

To close, I'll outline some ways in which structural fundamentality is a good for Sider's view, but also a way in which it isn't. I won't try to resolve the issue.

Four points of good fit are as follows. First, I argued in two ways that Sider's view entails that fundamentality is opaque; structural but not generative fundamentality explains how that could be. Second, I offered Completeness and Closure as candidate general principles operative in Sider's view; structural fundamentality naturally includes versions of both principles, whereas generative fundamentality doesn't. Third, Sider's view includes fundamental logical operators; I argued that structural but not generative fundamentality provides further support for fundamental logical operators. Fourth, I argued that structural but not generative fundamentality can play Sider's epistemic role for fundamentality.

The fit is not perfect because Sider (2011, pp. 137–141) argues that fundamentality is fundamental, whereas structural fundamentality is not structurally fundamental. Fundamentality attributions $\textsc{fund}(\alpha)$ syntactically combine a simple fundamentality operator $\textsc{fund}$ with an argument term α. But the above truth-condition for fundamentality attributions is relational: the decomposition captured by the syntactic structure of α is a deep structure of the denotation of α. This suggests that $\textsc{fund}(\alpha)$ is not a maximally perspicuous way of expressing that truth-condition because it uses the monadic fundamentality operator rather than relational vocabulary. There is no monadic property of being structurally fundamental in my account of structural fundamentality. So "self"-applications of structural fundamentality $\textsc{fund}_{\langle\sigma\rangle}(\textsc{fund}_{\sigma})$ will be false: structural fundamentality is not structurally fundamental.

A supporting argument is also available to show that the deep structure of a structural fundamentality attribution $\textsc{fund}(\alpha)$ is not an attribution of a monadic property of structural fundamentality to the entity denoted by the argument term α. Suppose that were their deep structure. Then $\textsc{fund}(a)$ and $\textsc{fund}(b)$ would express propositions with the same deep structure, if a co-denotes with b. In which case $\textsc{fund}(a)$ and $\textsc{fund}(b)$ would have the same truth-value, and $\textsc{fund}$ could not then be opaque. The deep structure of the proposition expressed by $\textsc{fund}(a)$ is therefore not an attribution of a monadic property of being structurally fundamental to the denotation of a. This suggests both that iterated structural fundamentality attributions $\textsc{fund}_t(\textsc{fund}_{\sigma}(a))$ and "self" attributions $\textsc{fund}_{\langle\sigma\rangle}(\textsc{fund}_{\sigma})$ are false: monadic structural fundamentality operators provide a non-perspicuous way of expressing relational propositions *x has deep structure y*. Opacity in structural fundamentality operators thus ensures that structural fundamentality is not structurally fundamental.

5 Conclusion

I've argued that the theory of fundamentality in *Writing the Book of the World* entails that the vocabulary of fundamentality is opaque. I ran the argument first for a particular case and then developed a more general version. In doing so, I offered Closure and Completeness as candidate structural principles operative in Sider's view. Although it's surprising that fundamentality gives rise to opacity, I argued that the structural conception can explain why the vocabulary of fundamentality is opaque and offers a good but not perfect fit for Sider's view.

Many open questions remain. Most pressingly, two problems for opacity in fundamentality stand out from §1. I'll finish by proposing solutions to both problems but cannot work through the details properly here.

The first problem was that fundamentality is supposed to be a central subject matter for metaphysics. Yet it is hard to see how that could be if fundamentality operators are opaque and so sensitive to the way entities are represented. The second problem was that my account of structural fundamentality operators makes no provision for quantification into their scope. Yet quantification-in is often required to state attractive general principles about fundamentality, such as Closure and Completeness. Workarounds to that limitation were available for present purposes but may not always be available.

The solution to the first problem is that structural fundamentality is not a central subject matter for metaphysics. Rather, deep structure is. What decompositions do propositions have, and which of them are deep structures? More generally, what laws and general principles govern deep structure? Is the joint carving thesis true? These questions are independent of how entities are represented and provide a central subject matter for metaphysics.

Relatedly, the solution to the second problem is that the vocabulary of deep structure is transparent. Generalisations about structural fundamentality can be replaced without loss by generalisations about deep structure, about decomposition, and about which linguistic items capture which decompositions. Those notions are transparent. So quantification into their scope is unproblematic. The opaque vocabulary of structural fundamentality provides a non-perspicuous way of expressing propositions more perspicuously expressed using these other transparent notions. Perspicuous metaphysical theorising should therefore use generalisations about deep structure, not about structural fundamentality.

Acknowledgements

For helpful feedback and discussion, I'd like to thank Peter Fritz, Chris Frugé, Alex Jackson, Lukas Skiba, Isaac Wilhelm, Al Wilson, and two anonymous referees for *Philosophical Studies*, as well as audiences in Dublin, Hamburg, and Oxford.

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