

# Is Naturalness Natural?

ABSTRACT: The perfectly natural properties and relations are special – they are all and only those that “carve nature at its joints”. They act as reference magnets; form a minimal supervenience base; figure in fundamental physics and in the laws of nature; and never divide duplicates within or between worlds. If the perfectly natural properties are the (metaphysically) important ones, we should expect being a perfectly natural property to itself be one of the (perfectly) natural properties. This paper argues that being a perfectly natural property is not a very natural property, and examines the consequences.

## 1. Introduction

David Lewis’ (1983) ‘New Work for a Theory of Universals’ motivates and develops a distinction between “perfectly natural” properties and relations,<sup>1</sup> and the rest. (Perfectly) natural properties are held to be simple, intrinsic, and non-gerrymandered. They are the properties that “carve nature at its joints”; those in terms of which fundamental reality can be described. The distinction between these and the less-than-perfectly-natural properties is put to work in many different ways, including to help solve problems with induction and reference, and to give accounts of phenomena as diverse as similarity, duplication and lawhood. Call the many who endorse this distinction in their metaphysical theorising “naturalness theorists”.

Lewis (1986 p. 61) holds that the distinction between the perfectly natural properties and the rest admits of degree. Properties can be ranked according to their relative degrees of naturalness, with the perfectly natural properties at the limit. There are two ways to characterise naturalness, depending on whether absolute naturalness or relative naturalness is taken to be the more basic notion.<sup>2</sup> Following Lewis, we will take the former notion to be basic.<sup>3</sup> Properties can be described using the one-place predicate ‘is perfectly natural’ (Taylor 1993, p. 84).

To convey that some property  $P_1$  is more natural than  $P_2$ , we define both  $P_1$  and  $P_2$  in terms of the perfectly natural properties, and compare the definitions. Lewis' suggestion (1984, p. 66; 1986, p. 61) is that  $P_1$  is more natural than  $P_2$  if the definition of  $P_1$  in terms of the perfectly natural properties is less complex than that of  $P_2$ . This is commonly understood (e.g. Sider 2011, p. 130) as a matter broadly of the length of the definition of the property in a language where all predicates stand for perfectly natural properties and relations (making allowances for, for example, taking disjunctions to be indicative of greater complexity than conjunctions).<sup>4</sup>

This paper argues that BEING PERFECTLY NATURAL is not itself a very natural property.<sup>5</sup> Such a conclusion has deeply troubling consequences for anybody who relies on the notion of naturalness to do serious metaphysical work. The perfectly natural properties are the important ones; they do the “metaphysical heavy lifting”. If the property that marks out the very distinction between the perfectly natural properties and the rest is not itself at least quite natural, then that distinction shouldn't be considered a particularly significant one. If PERFECT NATURALNESS isn't particularly natural, then accepting naturalness theory makes metaphysics out to be a fairly arbitrary enterprise.

Here's the plan. In section 2 I'll discuss a number of aspects of the role of the perfectly natural properties in Lewis' theory, and I'll argue that PERFECT NATURALNESS falls short of fulfilling that role. In section 3 I'll consider and reject the possibility that PERFECT NATURALNESS might nevertheless be fairly natural, and in section 4 I'll discuss in some more detail the consequences of my contention that it isn't.

## 2. The naturalness role

Naturalness is usually taken to be primitive, in the sense that no explanation of naturalness can be given in terms of anything else. Instead, naturalness is often introduced by example: the property BEING GREEN is thought to be more natural than the property BEING GRUE,<sup>6</sup> the property BEING A PLANT is thought to be more

natural than the property BEING ONE SIDE OF A RED DIE OR BARACK OBAMA'S LEFT HAND. Naturalness is a theoretical posit, and like other such posits, its meaning is fixed by a collection of its theoretical uses. My aim in this paper is to ask whether PERFECT NATURALNESS itself has the features that count towards a property's being perfectly natural according to naturalness theory.

In what follows I present such theoretical uses as necessary conditions on a property's being perfectly natural. This comes with a caveat: not all friends of naturalness agree that each of these aspects of the naturalness role must be satisfied by every perfectly natural property, and many also consider some aspects to be a greater indicator of perfect naturalness than the rest. The aspects of the naturalness role I consider in this section are: empirical discovery and figuring in laws; providing a minimal supervenience base; intrinsicality and duplication; and reference magnetism.

There are a few other indicators of perfect naturalness mentioned in Lewis' works. For example, he claims that the perfectly natural properties are simple, that they are highly specific, and that the naturalness facts are non-contingent (see e.g. Lewis 1983; 1986, p. 60). I assume here that the naturalness facts are non-contingent.<sup>7</sup> The idea that the perfectly natural properties are simple is understood as the claim that one property is more natural than another if the former has a definition in terms of perfectly natural properties that is simpler than any such definition of the latter. This is discussed with regards to PERFECT NATURALNESS in section 3. Related to simplicity is the claim that perfectly natural properties are highly specific. We can note immediately that BEING PERFECTLY NATURAL is not highly specific, because there are a number of ways a property might be perfectly natural (corresponding to the different perfectly natural properties). CHARGE is perfectly natural in virtue of being CHARGE, SPIN in virtue of being SPIN, and so on.

## 2.1 Empiricism and laws

It is an aspect of the naturalness role that  $P$  is a perfectly natural property iff  $P$  appears in fundamental physics. Lewis is clear that if there is an egalitarianism

amongst properties (so that a minority are to be considered elite) it ought to be the fundamental physical properties as discovered and named by physicists that have the elite status (e.g. Lewis 1984, p. 228; 1986, p. 60). Modern day physicists talk in terms of properties that modern day metaphysicians class as natural properties (e.g. CHARGE, MASS, SPIN) but there is no talk of a property of NATURALNESS amongst physicists, and no reason to think that this is likely to change. The physicists' task of giving a characterisation of fundamental reality is complete once an inventory of the fundamental entities and their interactions has been given. There is no need for physicists to add that the properties and relations they have discovered are perfectly natural.

A closely related condition on naturalness is that  $P$  is a perfectly natural property iff  $P$  figures in the best deductive system(s). Lewis takes the laws of nature to be the axioms of whichever theory best maximises simplicity and strength (where strength is a matter of virtues such as predictive power, unity, coherence, and consistency). Just as science discovers the perfectly natural properties, it also discovers the laws, and so the two are inseparable (Lewis, 1983, p. 365). It is the perfectly natural properties that will feature in the laws of nature, where those laws are the laws of the best deductive system(s). But whilst the laws of nature at this world seem to involve perfectly natural properties like CHARGE, MASS, and SPIN, there is no mention of PERFECT NATURALNESS by scientists, and so no scientific laws involving PERFECT NATURALNESS.

Perhaps what matters is that PERFECT NATURALNESS plays a fundamental role in our best *total* theory, which might contain some elements not of particular interest to physics (or to the other sciences). Then PERFECT NATURALNESS might feature in a best total theory, and thus appear in the laws of the best system, irrespective of its apparent absence from empirical investigation. On such an account, PERFECT NATURALNESS still fails to satisfy the element of the role of the natural properties that has them feature in physics, but its claim to naturalness may nevertheless be

justified by appeal to more theoretical metaphysical considerations. Such considerations are addressed in the following subsections.

## 2.2 Supervenience

The perfectly natural properties are taken to provide a complete characterisation of the world, such that all facts supervene on facts about which things have which perfectly natural properties. In Lewis' terms, one of the primary roles of the perfectly natural properties is that of providing a supervenience base. Lewis' taste for parsimony leads him further to take the perfectly natural properties to form a *minimal* supervenience base – 'there are only just enough of them to characterise things completely and without redundancy' (Lewis 1986, p. 60). We can say then that  $P$  is perfectly natural iff  $P$  is a member of a minimal supervenience base (MSB).

A minimal supervenience base must fulfil the following two conditions. First, it must be a set  $S$  of properties and relations such that that there can be no difference between any two worlds without a difference with respect to at least one of the members of  $S$ . This guarantees that everything supervenes on the properties within the base, and thus that the perfectly natural properties characterise things completely. Second, it must be such that there is no subset  $S'$  of  $S$  that fulfils the first condition. This guarantees that the base be minimal, because should  $S'$  fulfil the first condition, the properties that are members of  $S$  but not of  $S'$  are redundant; a complete characterisation of things can be given without them.

Standard definitions of supervenience are unrestricted – they quantify over all words whatsoever. When the  $A$ -properties supervene on the  $B$ -properties there can be no worlds at which there is a difference in  $A$ -properties without a corresponding difference in  $B$ -properties. Thus, if all properties supervene on the perfectly natural properties, then membership of the MSB will be non-contingent in the sense that no property can be perfectly natural *at any world* without being a member of the base. This allows for the possibility of alien natural properties (i.e. properties that do not exist at this world, but exist and are perfectly natural at some other(s)), but does not

allow that properties be perfectly natural at some worlds at which they exist, but not at other worlds at which they exist.

It might be that there are multiple candidate sets of properties that can fulfil the conditions for being an MSB. For example, we might replace any member of the set  $S$  of perfectly natural properties that make up the MSB with its negation, thus generating an alternative MSB that still fulfils the conditions of supervenience and minimality. But a defender of naturalness theory is unlikely to endorse this particular suggestion, because it will lead to problems with other aspects of the naturalness role (whilst HAVING SPIN might be a reference magnet, NOT HAVING SPIN presumably is not). Even if we were unable to specify a unique MSB, we could still consider whether PERFECT NATURALNESS might be a member of *some* MSB. We turn to this task now.

The Lewisian line is that when two possible worlds differ about the truth value of at least one proposition, they differ with regards to the truth value of at least one proposition that predicates a perfectly natural property of some entity (or a perfectly natural relation of some entities) (Dorr and Hawthorne 2013, p. 10). Because no MSB contains any properties that supervene on other properties within the base, for every property within the MSB there ought to be at least one proposition whose truth value differs only depending on that property's being predicated of some entity. This guarantees that every property which is a member of the set  $S$  of properties that make up the MSB earns its place, and therefore that the base is truly minimal. (Of course, some members of  $S$  might be responsible for a difference between a pair of worlds  $W_1$  and  $W_2$  neither of which is the actual world, but this is just another way of saying that there might be alien perfectly natural properties).

The only propositions whose truth value will differ only depending on the predication of 'is a perfectly natural property' will be propositions *about* which properties are perfectly natural. Orthodoxy has it that which properties are perfectly natural is not a contingent matter (see e.g. Lewis 1986, p. 61) and so any proposition predicating perfect naturalness of some property will be necessary. There is therefore

no proposition whose truth value differs based on the predication of ‘is a perfectly natural property’ of some property, and so according to any specification of MSB, PERFECT NATURALNESS will not be a member of  $S$  because that property fails to satisfy the requirement that each member of  $S$  should be responsible for a difference between some two worlds.

Given that no set of properties of which PERFECT NATURALNESS is a member can form a *minimal* supervenience base, a defender of the supervenience aspect of naturalness theory might suggest weakening the characterisation of a supervenience base so that minimality is no longer central, in the hope that PERFECT NATURALNESS might then prove a legitimate member of the base. This could be done in one of two ways: (a) by allowing “near-enough” natural properties to feature in the base, or (b) by specifying conditions under which properties that appear to supervene on one-another might nevertheless make up part of the base. I will argue that any such weakening that retains the spirit of the supervenience aspect of the naturalness role will not allow PERFECT NATURALNESS to feature in the set of properties that comprise the base.

The first argument for weakening the minimality condition on the supervenience base comes from the apparent possibility of infinite complexity, both in the actual world and in other possible worlds. There are various plausible scenarios involving certain kinds of infinite complexity that make it the case that properties are endlessly supervenient on lower-level properties (Schaffer 2004, p. 99). For example, it might be that the world is “gunky” – that matter is infinitely divisible. Just as proton-properties supervene on quark-properties, it might be that the quark-properties supervene on lower level properties corresponding to smaller sub-atomic particles that compose the quarks, and so on “all the way down”. At such worlds, there can be no set of properties that characterise things completely and without redundancy. For any property  $P$  that is a candidate for inclusion in the set of perfectly natural properties, there are some other properties upon which facts about  $P$  supervene, thus rendering  $P$  redundant in any characterisation of an MSB.

Lewis himself takes infinite complexity to be a genuine (albeit far-fetched) possibility, and suggests that we might therefore take the “near-enough” natural (NE-natural) properties to play the natural property role (Lewis 2009, p. 218). Lewis holds that these NE-natural properties can form a base (though not, of course, a minimal base) upon which everything else supervenes. Whatever properties are the NE-natural ones, the property of BEING AN NE-NATURAL PROPERTY (which will be the relevant property if NE-natural properties play the naturalness role), will supervene on the NE-natural properties themselves. NE-NATURALNESS will therefore not form part of the supervenience base.

An alternative way to deal with the relevant kind of infinite complexity whilst continuing to endorse naturalness theory is to reject what Schaffer (2004) calls the ‘fundamental’ conception of perfectly natural properties, opting instead for a ‘scientific’ conception, where perfectly natural properties are drawn from every level of a scientific characterisation of the world. On such a view, economic and psychological properties, along with physical and chemical properties might all contribute to the set of perfectly natural properties. What is important is that the perfectly natural properties provide an ontological base that makes true all of the truths at a world (Schaffer 2004, p. 100).

It is not clear that even on this sort of account, PERFECT NATURALNESS ought to count as a perfectly natural property. There is little reason to think that PERFECT NATURALNESS enters into a scientific characterisation of the world at any level, and less still to think it plays a role in making true any of the truths at a world that are not already made true by the perfectly natural properties. Fundamental metaphysics is not a special science.

The second way in which the characterisation of the base might be weakened (in such a way that the base might include PERFECT NATURALNESS) does not turn on infinite complexity. Fine (2001, p. 11) offers the mass, volume and density of a homogenous fluid as a case of three parameters where the value of any one parameter supervenes on the values of the two others. We cannot, on pain of



arbitrariness, stipulate which two parameters ought to be included in an MSB, and for each parameter there is good reason not to include it – that its value supervenes on the values of the other two. Nevertheless, unless at least two parameters are included, we will be unable to give a complete characterisation of things. It is therefore impossible, if MASS, DENSITY and VOLUME are taken to be perfectly natural properties, to give a complete and non-redundant characterisation of things.

A defender of naturalness theory might attempt to use this example to show that there can be members of an MSB that supervene on other properties within the base. But this is really just a counterexample to the idea that there is a single, *unique* MSB, and this is an idea we have already been forced to forgo. The example above indicates that there are at least three minimal supervenience bases, each of which contains a different pair of the three parameters discussed. Our question is whether perfect naturalness features in *any* MSB, and it seems it does not.

Whilst any two of MASS, DENSITY and VOLUME might appear in an MSB, no MSB will include PERFECT NATURALNESS because PERFECT NATURALNESS supervenes on all of the properties within the base (since, by hypothesis, the properties that form the MSB are all and only the perfectly natural ones). Any set *S* of properties that has PERFECT NATURALNESS as a member will have a proper subset that excludes *S* and that nevertheless characterises things completely. The same cannot be said for MASS, DENSITY and VOLUME, since whether any one of those parameters can be excluded and reality still be completely characterised will depend on which other of the parameters are members of *S*. The characterisation of an MSB cannot be weakened in such a way that MSB might include PERFECT NATURALNESS and still play the required aspect of the naturalness role.

There is a further, related aspect of Lewis' characterisation of the perfectly natural properties that prevents PERFECT NATURALNESS from fulfilling the supervenience aspect of the naturalness role. Lewis (e.g. 1983, p. 358) argues that the perfectly natural properties ought to be mutually independent. Even on the weakest formulation of mutual independence, which holds that facts about no perfectly

natural property supervene on facts about all of the others, PERFECT NATURALNESS cannot be considered a perfectly natural property; facts about PERFECT NATURALNESS supervene on facts about all of the other perfectly natural properties. This argument is independent of any considerations about a minimal supervenience base.

### 2.3 Intrinsicity and Duplication

For Lewis, intrinsicity and duplication are related in a tight circle of interdefinition. All perfectly natural properties are intrinsic, though not all intrinsic properties are natural (Lewis 1983, p. 357). (The property BEING GREEN is a plausible example of an intrinsic but not particularly natural property, whilst HAVING A POSITIVE CHARGE is perhaps both intrinsic and perfectly natural.) A property *P* is perfectly natural iff it makes for perfect intrinsic duplication. Perfect duplicates share all of their perfectly natural properties, and the parts of perfect duplicates can be put into correspondence in such a way that corresponding parts have exactly the same perfectly natural properties (and stand in exactly the same perfectly natural relations) (Lewis 1986, p. 62). Two things are perfect duplicates iff they have exactly the same intrinsic properties, and intrinsic properties never divide duplicates within or between worlds (Langton and Lewis 1998, p. 336).

Imagine a machine that creates perfect duplicates in accordance with Lewis' recipe. If the machine duplicates electron *e*, it must take in to account factors such as the MASS, SPIN and CHARGE of *e* – those are its natural, and therefore intrinsic properties. The machine need not take into account *e*'s location, which objects it is a part of, or how it moves relative to external observers – those are extrinsic and therefore unnatural properties. PERFECT NATURALNESS is a property of properties, and we can assume that the naturalness of a property is intrinsic to it.<sup>8</sup> If PERFECT NATURALNESS were itself perfectly natural then when the duplicating machine duplicated a given first order property, it ought to take into account the degree of naturalness enjoyed by the property being duplicated. If we could show that property duplication involved such a consideration, it would suggest that PERFECT

NATURALNESS fulfils the duplication aspect of the naturalness role. But property duplication is immediately problematic. To see this, we can consider how various theories about the nature of properties might account for property duplication.

First, consider the view that properties are abstract universals. Discounting (because it offers up no answers to the question at hand) the trivial sense in which everything might be said to be a duplicate of itself, duplicate universals requires the possibility that there be two of the same universal. This would undermine much of the motivation for appealing to universals in the first place. Here's an example: we appeal to the universal GREEN in order to give an account of what this green chair and that green ball have in common. If there are multiple GREEN universals, there is no guarantee that any universal is shared by the chair and the ball (perhaps there is a different universal corresponding to each green thing).

The above problem will also apply if properties are concrete, immanent universals (such that the universal is multiply located in its instances); there is no universal that is guaranteed to be shared by the different objects that instantiate the property in question. A further problem also emerges on a conception of properties as immanent universals - we cannot feed BEING GREEN into the duplication machine, because we cannot extract BEING GREEN from its instances. Suppose then we feed a green apple into the duplication machine. The machine will duplicate all of the perfectly natural features of the apple, and the duplicate will indeed be green. But all we have done is duplicate the apple. The greenness of the apple was duplicated in virtue of its supervenience on the perfectly natural properties of the apple, and thus the machine had no need to take the naturalness status of BEING GREEN into account.

Suppose instead that we take properties to be sets of their instances. Under this conception, to duplicate a property would be somehow to duplicate the set of all of its instances. Since both the original and the duplicate sets would have the same extension, this is a violation of the extensionality axiom of set theory, which states that sets with the same elements are identical (i.e. are the same set).<sup>9</sup>

Perfectly natural properties are shared between duplicates, but property duplication seems metaphysically impossible. Consequently, the duplication aspect of the naturalness role is at best only trivially satisfied with respect to properties. Whilst BEING PERFECTLY NATURAL doesn't violate the relevant condition on perfectly natural properties (that they not divide perfect intrinsic duplicates within or between worlds), non-violation of that condition gives us no reason to think that PERFECT NATURALNESS is perfectly natural. As applied to properties, this constraint on perfectly natural properties does not give us an informative criterion for assessing perfect naturalness.

Worse, like PERFECT NATURALNESS, properties such as BEING A PROPERTY will also trivially satisfy the duplication role of a perfectly natural property. If we grant that the criterion is trivially satisfied with respect to BEING PERFECTLY NATURAL, we must also accept that it gets what is intuitively the wrong result when applied to other second order properties. The false positives that are generated by this trivial satisfaction of the duplication role at the level of second order properties casts some more general doubts on Lewis' project of outlining the naturalness role. A Lewisian conception of naturalness builds a number of specific commitments in to the theory (for example, the idea that for a property to be perfectly natural, it must be metaphysically possible to duplicate whatever instantiates that property). This should be considered a cost for naturalness theory, because it makes its acceptance contingent on the acceptance of other metaphysical baggage.

## 2.4 Reference magnetism

Lewis (1984, p. 227) argues that *ceteris paribus*, the natural properties provide more eligible referents for the predicates of our language. A property *P* is perfectly natural iff *P* is a *reference magnet*. On the usual interpretation, Lewisian metasemantics involves constructing an interpretation of a language that best balances two factors. The first is use, where we are to interpret people's actions, and therefore their mental states (and, indirectly, their language) as maximally rational, given their environment. The second is eligibility, where eligibility is accounted for in terms of naturalness. Crudely,

the thought is along the lines that even if our theory about electrons contains some false propositions about, for example, CHARGE, CHARGE is so eligible to count as the referent of our expression “charge” that it is still CHARGE we refer to, even though we believe and state some false things about it. (The extreme alternative would be to hold that since we intend to speak truly, the referent of our expression “charge” must be whatever property makes all of our charge-involving platitudes come out as true, presumably a highly gerrymandered and unnatural property).

Our question here, then, concerns the eligibility of PERFECT NATURALNESS to serve as the referent of our expression “perfectly natural”. But we as speakers of the language are in no position to make judgments concerning the eligibility of particular things to be referents. The alleged strength of reference magnetism depends on the eligibility of things to be referents being an *external* constraint on the metasemantic theory (see Lewis, 1984). Our intention to refer in such a way that our platitudes come out as true will be the same whether or not any of the candidate referents for our expression are perfectly natural, and so we will be unable to judge which are the reference magnets based on our own attempts to refer. Since we are not in a position directly to address the eligibility of PERFECT NATURALNESS to serve as a reference magnet, I’ll instead make a general point about the role of the reference magnets in Lewis’ semantic theory, and then consider a related question concerning the extent to which the expression “perfectly natural” is vague.

That the perfectly natural properties can act as reference magnets is an aspect of naturalness theory that is taken to be particularly useful when it comes to solving philosophical puzzles. For example, an appeal to reference magnetism can account for why the expression “plus” refers to addition rather than quaddition,<sup>10</sup> and why the expression “green” picks out the class of green things, and not that of grue things. Naturalness theory has it that addition is a more natural function than quaddition, and that GREEN is more natural than GRUE. The more natural the property, the more eligible it is to be the referent of our expressions, and so our expressions refer to addition and GREEN and not to the gruesome alternatives. (Note

that GREEN is not itself a perfectly natural property, but because it is related via a shorter definitional chain than GRUE to the perfectly natural properties, it is GREEN that draws the reference of our expression “green”.)

The purpose of reference magnetism is to constrain interpretations of a language, and so we might consider how much interpretations are constrained if we take PERFECT NATURALNESS to be a reference magnet. Because (as we saw in section 2.2 above) all properties supervene on the perfectly natural properties *excluding* PERFECT NATURALNESS, it is hard to imagine that even if PERFECT NATURALNESS were extremely eligible to act as a reference magnet, it could offer any further constraint on the interpretation of a language than that offered by the perfectly natural properties themselves.<sup>11</sup>

The friend of naturalness might be tempted by a line of response which holds that PERFECT NATURALNESS must be eligible enough to constrain interpretations of the expression “perfectly natural” and ensure that all and only the perfectly natural properties fall under the predicate ‘is a perfectly natural property’. To serve this purpose, PERFECT NATURALNESS must be a reference magnet. But this line of argument is problematic.

The friend of naturalness who argues in this way risks falling into the “just more theory” trap (see Lewis 1984, p. 228); reference magnetism cannot be a semantic theory that includes platitudes like ‘perfect naturalness is a reference magnet’ and ‘all and only the perfectly natural properties fall under the predicate ‘is a perfectly natural property’’, because such a theory can be satisfied in countless ways which assign countless different extensions to “perfect naturalness”, “reference magnet” and so on. Reference magnetism must be a *constraint* on the eligibility of referents, and not merely the requirement that naturalness theory be satisfied. Any argument the friend of naturalness gives for the eligibility of PERFECT NATURALNESS to serve as a referent of our expression “perfectly natural” will fall into the “just more theory” trap’, and so the eligibility constraint is one we must simply suppose exists, and we

cannot try to argue for it. If this is unpalatable, then so much the worse for the doctrine of reference magnetism.

A closely related question may shed more light on the issue. Dorr and Hawthorne (2013, pp. 59-68) are interested in assessing the level of *vagueness* in the expression ‘perfectly natural’. If the expression ‘perfectly natural’ is vague, that would be a good indication that PERFECT NATURALNESS is not very natural. If, on the other hand, “perfectly natural” is precise, one good explanation (assuming the truth of reference magnetism) for its precise nature is that there is a joint carving interpretation of the expression.

There are (at least) two ways that “perfectly natural” might be vague. First, there might be multiple equally good candidate interpretations of the expression (i.e. there might be multiple sets of properties that each fully satisfy the naturalness role, with none eligible enough to fix a determinate referent). Second, there might be *no* set of properties that definitely satisfies the naturalness role (even though the role is fully satisfied by the perfectly natural properties).

One reason given by Dorr and Hawthorne (2013, pp. 63-4) for thinking that “perfectly natural” is at least somewhat vague (in the first of the two ways) is that there are some interdefinable properties (e.g. Fine’s (2001) example of MASS, DENSITY and VOLUME in a homogenous fluid; some properties of Euclidean geometry; some mereological properties) such that one ought to be taken as perfectly natural and the other defined in terms of it, but there seems to be no reason to prefer taking either one as perfectly natural over the other.

An attractive option is then to claim that there is no determinately correct answer to the question of which of these properties are the perfectly natural ones. There is no reason to prefer, for example, PARTHOOD over PROPER PARTHOOD, or vice versa, as the more natural notion, and so there are different sets of perfectly natural properties, some which include PARTHOOD and others which include PROPER PARTHOOD (and none which include both). Since each of these sets of properties is an equally good candidate interpretation of the expression “perfectly natural”, that

expression is at least somewhat vague. The alternative (corresponding to the second of the two ways in which “perfectly natural” might be vague) is that the case of properties like PARTHOOD and PROPER PARTHOOD serves to indicate that there is no set (rather than multiple sets) of all and only the perfectly natural properties.

Of course, the friend of naturalness can respond that there *is* a unique set of perfectly natural properties, notwithstanding our apparent inability to determine what it is, and thus to maintain that “perfectly natural” is precise. But this is a move that incurs a heavy burden of proof. It is generally a bad idea to believe things we have no clear evidence for, especially when there are indications to the contrary.

A different reason to think that there might be a reasonable degree of vagueness in the expression ‘perfectly natural’ is that PERFECT NATURALNESS is taken to be a theoretical primitive, and thus is not given an explicit definition. PERFECT NATURALNESS is introduced by example and by explicating the theoretical role it is taken to play, but one might worry that this will not be enough to eliminate vagueness from the expression “perfectly natural” (compare the sceptical challenge mounted against the grounding relation in Daly (2012)). The expression “perfectly natural” might be vague even when the entire naturalness role is satisfied, and so one might think that introducing the naturalness role and pointing out examples will not be enough to make the expression precise.

It seems likely that the expression “perfectly natural” is at least somewhat vague, and thus unlikely that PERFECT NATURALNESS is an extremely eligible referent for our expression. Moreover, there is little theoretical work to be done by taking PERFECT NATURALNESS to be a reference magnet, and arguments the friend of naturalness might give for the eligibility of PERFECT NATURALNESS go the way of the just-more-theory trap. Though the discussion here is admittedly a little inconclusive (the friend of naturalness is in a position simply to dig in her heels) it seems to suggest that PERFECT NATURALNESS is not a reference magnet, and therefore fails to fulfil yet another aspect of the role of a perfectly natural property.



### 3. How natural is PERFECT NATURALNESS?

The arguments of the previous section show that PERFECT NATURALNESS fails to fulfil some key aspects of the naturalness role. It is not the kind of thing that is discovered or identified through empirical investigation or is involved in physical laws; it fails to form part of a minimal supervenience base; and there is little sense to be made of it playing a role in duplication, or being intrinsic to its bearers. There are reasons to think that PERFECT NATURALNESS is not a reference magnet. Putting this all together suggests that PERFECT NATURALNESS is not a perfectly natural property.

Whilst from our assessment above it seems that PERFECT NATURALNESS is in fact quite unnatural (because of the ways in which it falls short of fulfilment of various aspects of the naturalness role) it is not obviously legitimate to infer from this that PERFECT NATURALNESS is anything other than not *perfectly* natural. We might then look to an alternative method for assessing the degree to which PERFECT NATURALNESS is natural.

As mentioned above, the Lewisian method for assessing the relative naturalness of a given property  $P$  is to consider the complexity of  $P$ 's definition in terms of the perfectly natural properties (e.g. Lewis 1986, p. 61). Recall that a definition of a property in this context is an expression which provides necessary and sufficient conditions, and definitions in terms of perfectly natural properties will be expressions in a language where all syntactically simple non-logical vocabulary expresses perfectly natural properties (Dorr and Hawthorne 2013, 19).

Sider (2011, p. 138) proposes that if PERFECT NATURALNESS itself is not perfectly natural then the following is a definition of PERFECT NATURALNESS (where  $N_n$  are all and only the perfectly natural properties):

$$P \text{ is perfectly natural} =_{\text{df}} P=N_1 \text{ or } P=N_2 \text{ or... } P=N_i$$

This definition is highly disjunctive, which makes it appear highly unnatural.<sup>12</sup> On this method of assessing naturalness, if PERFECT NATURALNESS is not perfectly natural, then it is highly unnatural (because it is defined in the above way).

Here's one way the friend of naturalness might respond: *This can't be the right way to define PERFECT NATURALNESS. The N terms are functioning in the definition as names for perfectly natural properties, rather than as predicates. If we allow names to feature in the definition in this way, then some intuitively very unnatural properties will turn out to be extremely natural.*

The following example illustrates the point. The predicate 'grue' applies to all objects that are green and observed before some future time  $t$ , and to other objects (observed at or after  $t$ ) just in case they are blue. Predicates functioning in this way stand for gruesome properties. Suppose that there are only two gruesome properties: GRUE and BLEEN. The definition for the intuitively highly unnatural property of GRUESOMENESS will be:

$$P \text{ is gruesome} =_{df} P = \text{GRUE or } P = \text{BLEEN}$$

GRUESOMENESS is defined with only two disjuncts, and so comes out as a highly natural property. Though both GRUE and BLEEN appear highly unnatural and thus not eligible for a place in the definition of GRUESOMENESS when stated in perfectly natural terms, the disjuncts in the above definition are functioning as names, and if we allow names to feature then the above definition is legitimate. Even worse, (as noted by Dorr and Hawthorne 2013, p. 19n30) if we allow names for properties and a predicate 'instantiates', we can define any property extremely simply with 'instantiates  $P$ ', where  $P$  is a name for the property in question. We would then have to count all properties as equally natural, because they all have a definition of equal length.

So we have good reason to think that names should be excluded from all definitions of properties in perfectly natural terms. How then are we to define PERFECT NATURALNESS? One suggestion might be to allow only a limited class of property names – those that denote the perfectly natural properties – to feature in the relevant definitions. But this will not help the friend of naturalness, because in that case the definition of PERFECT NATURALNESS will be the complex, disjunctive definition given above. In the absence of an alternative method for assessing how natural non-perfectly natural properties are, the friend of naturalness is unable to give an account

of how natural PERFECT NATURALNESS is. This is something of a dilemma for the friend of naturalness: she must either accept the complex, disjunctive definition given above; or she must come up with an alternative method for assessing the naturalness of less-than-perfectly natural properties (and show that by its lights, PERFECT NATURALNESS is highly natural).

The first horn of the dilemma is the conclusion we can assume the friend of naturalness is trying to avoid (its consequences are discussed in the next section). What of the second horn? There is much work to be done even to come up with a systematic method for assessing naturalness, let alone to demonstrate that PERFECT NATURALNESS will turn out highly natural by its lights. In the absence of such a method,<sup>13</sup> the only other thing the friend of naturalness can do is to try to reject the dilemma. I turn to that response now.

Perhaps there is an implicit restriction within naturalness theory such that it applies only to first-order properties (i.e. properties of non-properties). There are a few ways such a restriction could be cashed out: perhaps it is only first-order properties that have a definition in perfectly natural terms; perhaps the naturalness role is to be filled only by first-order properties; or perhaps only first-order properties can be ranked according to their degrees of relative naturalness. In any of these cases, questions about the naturalness of PERFECT NATURALNESS, a second-order property, would be illegitimate, or confused, and so the dilemma presented above would be a false one.

There are two replies to the suggestion that naturalness theory might be restricted in one (or more) of these ways. The first is that the claim has an air of ad hocery about it. Questions about the naturalness of PERFECT NATURALNESS certainly seem grammatical and well-formed in English (we have, for example, spent the last while attempting to answer them as if they were well-formed). In any case, it is not always a mistake to apply predicates to higher-order properties. The predicate 'is a property', for example, seems as though it can be correctly applied to a property of any order. To make predicates involving naturalness a special case certainly adds to the complexity of the theory, and is thus an unanticipated theoretical cost for the friend

of naturalness who embarks down this road in response to the problems identified above.

The second reply appeals to an argument for the necessity of perfectly natural second order relations discussed in Eddon (2013). Eddon's argument is that in order to give an account of quantitative properties (e.g. TWO GRAMS MASS) that preserves a necessary ordering of such properties (e.g. TWO GRAMS MASS is less than THREE GRAMS MASS) and distance between them (e.g. the distance between TWO GRAMS MASS and THREE GRAMS MASS is one gram), we require perfectly natural second-order relations holding between the quantitative properties.

Without such relations, there is no plausible way (see Eddon 2013 for a discussion and rejection of possible alternatives) to give an account of why it is that, for example, two objects instantiating 2 GRAMS MASS and 3 GRAMS MASS respectively resemble one another more closely than they do an object instantiating 1000 TONNES MASS. Eddon argues that appeal to first order natural properties cannot distinguish between them since each object instantiates different quantities of mass, and thus none of them share any perfectly natural properties (appeal to the determinable MASS that each instantiates fails to capture degrees of resemblance between them). The difference cannot, Eddon argues, be explained by appeal to non-fundamental second-order relations since there will be myriad such relations and no way (without appeal to perfectly natural second-order relations) to distinguish any which is privileged.

Eddon thus provides good reason to think that there must be perfectly natural second order relations.<sup>14</sup> If there are some such relations, it cannot be the case that perfect naturalness is restricted so as to range only over first-order properties and relations. To claim that the restriction on perfect naturalness is only such that PERFECT NATURALNESS itself cannot be evaluated in terms of naturalness is ad hoc and therefore cannot be maintained. PERFECT NATURALNESS is an unnatural second order property.

## 4. Consequences

What are the consequences if, as the arguments of the previous section give us reason to believe, naturalness is not very natural? It might be tempting to think that if PERFECT NATURALNESS is not a natural property, then the perfectly natural properties are not natural either. Without further argument, this is just a confusion. Suppose some property *P* is a simple property, but the property BEING A SIMPLE PROPERTY is extremely complex (highly disjunctive, for example). The complexity of SIMPLICITY need not infect the simplicity of *P*. It would be obviously mistaken to infer from the complexity of SIMPLICITY that properties instantiating SIMPLICITY are thereby complex, and it is similarly mistaken to infer from the unnaturalness of PERFECT NATURALNESS that perfectly natural properties are in fact not perfectly natural.

The unnaturalness of PERFECT NATURALNESS is, however independently unpalatable. This is so for two reasons: the first reason is methodological (it undermines the explanatory role that the natural properties are taken to play); and the second reason is metaphysical.

The suggestion that PERFECT NATURALNESS might be fairly unnatural is considered by Sider (2011, pp. 138-9) under the title of “Melianism” (after conversation with Joseph Melia). Sider’s Melian embraces the unnaturalness of PERFECT NATURALNESS, on the grounds that PERFECT NATURALNESS itself is never involved in explanations, only particular natural properties. The claim is that it is not a problem that PERFECT NATURALNESS itself is not included in the fundamental picture of the world, because the perfectly natural properties are. When we give accounts that appeal to naturalness, they in fact appeal to particular (perfectly) natural properties. This is the case even if we are unaware which of the natural properties is playing a particular role – the correct account of things invokes some particular natural property or other, and so there is no need for inclusion of the general notion of naturalness in that account.

Sider (2011, p. 139) thinks that Melianism undermines all of the applications of naturalness. Sider has a conception of naturalness theory as fundamental in our description of the world because it offers an explanation of important metaphysical aspects of reality, as detailed in section two above. Sider claims that if naturalness is as unnatural as the Melian supposes, naturalness theory could not be explanatory. The Melian responds by citing only particular natural properties to do the necessary work, but Sider's argument is that explanations require generalisations. For generalisations about naturalness to be explanatory, naturalness cannot have a Melian definition.

Consider an event such as the breaking of a window. We can provide an explanation for that event in terms of properties such as the fragility of the window and the force of the ball that came flying at it. What we cannot do, if naturalness is not natural, is explain why that makes for a good explanation (i.e. because it cites properties that are natural enough in the relevant context, and the explanation depends on some laws of nature which involve perfectly natural properties). As Sider (2011, p. 139) argues, the unnaturalness of (PERFECT) NATURALNESS makes attempts to give accounts of lawhood, duplication, reference etc. in terms of (PERFECT) NATURALNESS seem an arbitrary exercise, and one not especially worth pursuing.

The second reason that naturalness must be at least fairly natural does not hinge on the explanatory role of the natural properties. The (perfectly) natural properties are supposed to be the important ones; those that carve reality at the joints; those that make for objective distinctions in reality. If BEING A PERFECTLY NATURAL PROPERTY doesn't itself carve reality at the joints and make for an objective distinction, then there is no metaphysically interesting distinction between this and other distinctions. There is no particular reason to be interested in the distinction between the perfectly natural properties and the rest any more than we are interested in numerous other distinctions between properties. Naturalness theory has it that the metaphysically significant properties are the natural ones, and so PERFECT NATURALNESS must be at least fairly highly natural if naturalness is to be

metaphysically significant. Given that naturalness theory is premised on the idea that naturalness *is* metaphysically significant, that PERFECT NATURALNESS seems fairly unnatural undermines the enterprise.

Universität Hamburg

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## Notes

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<sup>1</sup> Henceforth, “property” should be taken to include relations.

<sup>2</sup> Lewis (1986, pp. 63-9) considers the possibility that neither notion is primitive, and that naturalness ought instead to be analysed in terms of some underlying posit. If this is the case, similar considerations to those addressed here ought to apply to that underlying posit, and so for simplicity I will assume here that some notion of naturalness is primitive.

<sup>3</sup> That this is the characterisation Lewis has in mind is evident from his discussions in, for example (1983, p. 376; 1986, p. 61).

<sup>4</sup> One reservation: Lewis says little about how this relative complexity is to be understood. In the absence of a clear account of simplicity, we are given no reason to think that an analysis of naturalness in terms of simplicity will be successful.

<sup>5</sup> Small capitals indicate property names throughout

<sup>6</sup> The predicate ‘grue’ applies to all things examined before some future time *t* just in case they are green, and to other things observed after *t* just in case they are blue.

<sup>7</sup> This assumption should be considered fairly benign, since it is both shared by Lewis and most of his followers, and does not affect most of the arguments made here. Those that it does affect (e.g. in section 2.2) can be reformulated in terms that do not assume non-contingency.

<sup>8</sup> The extent to which a given property is natural seems to be given purely by the way the property is; not in virtue of the way in which that property interacts with the world.

<sup>9</sup> Note that there is plausibly a subtle difference between duplicate sets formed by duplicating their members, and duplicating sets themselves. An example of the former case would be taking the unit sets of two duplicate electrons to be duplicate sets. Here the sets can be distinguished through differences in the extrinsic properties of their members. In the latter case of duplicating the sets themselves (which I claim here is impossible), the sets could not be so distinguished.

<sup>10</sup> The puzzle here is Kripke’s (1982) version of a puzzle considered by Wittgenstein; competent thinkers intend to perform addition and not *quaddition* when they see the ‘+’ sign. Quaddition functions like addition for small numbers, but yields the answer 5 should any of the numbers to be quadded exceed a certain limit.

<sup>11</sup> An exception, of course, is that it constrains interpretations of the expression “perfectly natural”, but interpretation of that expression will otherwise be constrained by interpretation of the expressions standing for the perfectly natural properties in terms of which PERFECT NATURALNESS can be defined (see section 3).

<sup>12</sup> Exactly *how* complex and disjunctive the definition is depends on how many perfectly natural properties there are. Given that there must be enough to characterise things completely, it is unlikely that the perfectly natural properties will be sparse enough to

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maintain that the disjunction of all of them is simple enough to indicate a very natural property.

<sup>13</sup> One possibility we might consider is looking at how well a given property *P* fulfils the role of a perfectly natural property, to give us an indication of how natural *P* is. That role is fairly well defined, and we can perhaps get a reasonably good handle on the extent to which *P* falls short of fulfilling it. For PERFECT NATURALNESS though, this assessment would suggest a fairly unnatural property (see section 2).

<sup>14</sup> This has the consequence that the minimality criterion in the account of the role that the perfectly natural properties play in comprising a supervenience base must be rejected. Any perfectly natural second order properties violate this aspect of the role in the same way as perfect naturalness does if we take it to be perfectly natural (though not to the same extent – perfectly natural second order relations of this kind do not supervene on *all* the other properties within the MSB). However, the relations that Eddon discusses do play most of the other aspects of the naturalness role, which is her motivation for taking them to be perfectly natural in the first place (see Eddon 2012 section 6). The presence of some perfectly natural second-order relations does not pose a threat to my overall argument here.

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