"The Nomic Role Account of Carving Reality at the Joints", *Synthese* 115 (1998): 171-198.

PETER VALLENTYNE

ABSTRACT: Natural properties are those that carve reality at the joints. The notion of carving reality at the joints, however, is somewhat obscure. It is sometimes understood in terms of making for similarity, sometimes in terms of conferring causal powers, and sometimes in terms of figuring in the laws of nature. I develop and assess an account of the third sort according to which carving reality at the joints is understood as having the right level of determinacy relative to nomic roles. The account has the attraction of involving only very weak metaphysical presuppositions, but it fails to capture several features that natural properties are presumed to have.

1. INTRODUCTION

Some properties, it is often supposed, are natural or genuine (e.g., being an aardvark), and some are gimmicky or fishy (e.g., being an aardvark or a pencil). Natural properties are those that carve reality at the joints, whereas gimmicky ones are those that don't. The notion of carving reality at the joints, however, is somewhat obscure, and can be understood in several different ways. I shall develop and assess an account of natural properties that understands reality's joints to be determined by the laws of nature. The general idea of such an account is not new, but the development and assessment that I give is.

Broadly speaking, there are three main accounts of carving reality at the joints. According to the similarity account, a property carves reality at the joints just in case it provides the basis for similarity judgements (e.g., for why a brown dog is more similar to a white dog than to a brown cat).[1] According to the causal powers account, a property carves reality at the joints just in case it confers causal powers (where, as explained below, this involves more than nomic connections).

According to the nomic role account, a property carves reality at the joints (roughly) just in case it has the appropriate level of determinacy relative to its nomic role (being neither too determinate nor too indeterminate relative to the sensitivities of the laws of nature). The similarity account, and the causal powers account, each presupposes a privileged set of properties (that ground similarity and causality respectively). Such a presupposition is viewed by many as metaphysically suspect. The nomic role account presupposes only the existence of properties and of laws of nature, and although this is not uncontroversial, it is much less controversial.

The main strength of the nomic role account is the weakness of its presuppositions. But precisely because of this weakness, the nomic role account, we shall see, is not able to capture various features that natural properties are commonly supposed to have. Although I am quite skeptical of the presuppositions of the similarity and of the causal power accounts, I shall not argue against those views. It may be that such presuppositions are necessary to solve various philosophical problems. My goal in this paper is more modest. I shall simply develop and assess the nomic role account on its own terms.

2. Background: Properties and Natural Properties

Before developing a specific conception of carving reality at the joints, I shall first elaborate on the general notions of property and natural property.[2]

A property, in the sense intended here, is a non-linguistic entity that (in the broadest sense) is instantiable, or that has a negation that is instantiable, and for which metaphysically necessary coextension is a necessary condition for identity. Properties may be n-place, for any n, but for simplicity I shall normally write in terms of monadic properties and leave the generalization implicit. Properties are logically abundant: if X and Y are properties, then so are any logical

variations and combinations that yield something that is capable of instantiation or which has a negation that is instantiable (i.e., as long as there is at least one "open position"). These variations and combinations include negation, disjunction, and conjunction, taking the converse of a relation, and partial quantification over a relation. Being-a-pencil-or-an-aardvark is, for example, a property.

Coarse-grained properties are properties for which metaphysically necessary coextension is necessary and sufficient for identity. Fine-grained properties are properties for which metaphysically necessary coextension is a necessary but insufficient condition for identity (e.g., having two feet is not the same fine-grained property as having two feet and being self-identical). For simplicity I shall focus solely on coarse-grained properties. I am skeptical that the laws of nature are sensitive to fine-grained properties in any non-derivative way, but if they are, the account I shall offer can be revised accordingly.[3]

Natural properties are properties that carve reality at the joints. Natural properties are generally presumed to be logically sparse in the sense that the set of natural properties is not closed under property-preserving logical operations. Being an aardvark or a dog, for example, may not be natural, even if being an aardvark , and being a dog, each are.[4]

On one conception of natural properties, they are understood as properties that are "wholly present as a non-spatio-temporal part" in whatever instantiates them. These are often called universals in contemporary terminology. Many philosophers (myself included) are quite skeptical of the meaningfulness and applicability of the notion of a property being wholly present as a non-spatio-temporal part in each of its instances, but I shall not here argue against the relevance of the notion. It may be that the perfect sense can be made of the notion, and that only by positing universals can we adequately resolve various philosophical problems (discussed below). My goal is to articulate a conception of natural properties that makes no appeal to the notion of being wholly

present in instances, and to assess the adequacy of this conception. (The similarity and causal power accounts mentioned in the introduction are typically developed in terms of universals.)

3. Nomic Roles

I shall develop and defend the nomic role account of natural properties, according to which natural properties are those properties that carve reality at the joints, where this is understood roughly as having the right level of determinacy relative to their nomic role. The account presupposes that there are laws of nature (which need not be deterministic).[5] More specifically, it presupposes that there are laws of nature that rule out some, but not all, metaphysically possible states of affairs. States of affairs that are compatible with the laws of nature are nomologically possible, and those that are not are nomologically impossible.[6]

Because the purpose of the nomic role account is to identify which properties are natural by appealing to the laws of nature, it presupposes that the laws of nature can be identified without previously explicitly identifying which properties are natural. I have offered such an account elsewhere, and won't go into details here.[7] Some accounts of lawhood, however, presuppose the prior identification of natural properties, and then identify laws as certain sorts of relations among natural properties. Although the nomic role account of natural properties is compatible with this general approach (although not necessarily with the details of any particular approach), the combination of the two will be circular and unenlightening.[8]

3.1 Three Conceptions of Nomic Role

What, then, is a nomic role? More precisely, how are nomic roles to be understood for the purposes of giving an account of natural properties? With respect to the notion of having the same nomic role, we should note three distinct accounts present in the literature:

Nomological Equivalency: Two properties have the same nomic role just in case they are nomologically equivalent (i.e., such that it is nomologically necessary that whatever instantiates one instantiates the other).[9]

Equipollency: Two properties have the same nomic role just in case they are (nomologically) equipollent (i.e., have the same nomic connections with antecedent, concurrent, and subsequent states).[10]

Equipotency: Two properties have the same nomic role just in case they are (nomologically) equipotent (i.e., have the same nomic implications concerning subsequent states).[11]

More will be said below about the notion of nomic equipollency, but the basic idea is that equipollent properties have the same nomic connections. These include both nomic implications, that is, what follows nomically from the instantiation of the property, and nomic enablers, that is what nomically leads, perhaps with a specified probability, to the possibility of the instantiation of the property. Thus, equipollency requires the same powers (to affect), susceptibilities (to be affected by), and covariances involving antecedent, concurrent, and subsequent conditions. Equipotency, on the other hand, only requires the same nomic powers to affect subsequent conditions.

Nomological equivalency entails equipollency, which entails equipotency, but the reverse entailments do not hold. Two properties with the same nomic powers are equipotent, but they are not equipollent, if they can be acquired in different ways. Two incompatible properties can be equipollent (same causes, effects, etc.) but they cannot be nomologically equivalent, since incompatible properties are never coinstantiated.

The nomological equivalency account of nomic role is too fine-grained in that it wrongly holds that nomologically indistinguishable (i.e., equipollent) properties may not have the same nomic role. Suppose, for example, that the laws of nature treat having a temperature of 40 degrees Celsius exactly the same as having a temperature of 40 plus one trillionth degrees Celsius. (Suppose, for example, that this difference in temperature is below some quantum threshold below which differences make no difference nomologically.) Whenever it is nomologically possible for an object to acquire/maintain/lose one property, it is also nomologically possible for it to acquire/maintain/lose the other, and whatever probability is associated with one is also associated with the other. (Which property is realized in a particular case is nomically random.) Furthermore, the nomic implications of the one are identical with those of the other. As far as the laws of nature are concerned, the two are the same, but the nomological equivalency account of nomic role wrongly classifies these properties as having different nomic roles, since the two are never coinstantiated.[12]

The nomological equipotency account of nomic role, on the other hand, is too coarse-grained in that it wrongly holds that properties with the same nomic powers, but which may be acquired in different ways, have the same nomic role. Now, sometimes, indeed perhaps most of the time, we are primarily concerned with the nomic powers of properties, and only secondarily with their nomically possible antecedents. And so for some purposes we will certainly want to focus on

equipotency classes of properties. But if we are interested in properties that carve reality at its nomic joints, that make all and only the distinctions that nature makes, then equipotency is too coarse-grained for a criterion of sameness of nomic role. For nature does distinguish between equipotent properties with different nomic antecedents. It says that the possibility or probability of acquiring one is different from that of acquiring the other. Thus, the equipotency account must be rejected as the relevant conception of nomic role. (Again, this is not to deny that for many purposes equipotency is of more interest to us than equipollency.)

Equipollency, on the other hand, is by definition sensitive to everything to which the laws of nature are sensitive. It is thus a plausible conception of nomic role. Because the equipollency account will be the basis for the account of natural properties, it will be useful to flesh this account out more before proceeding to the account of natural properties.

3.2 Nomic Role vs. Causal Role

Equipollency requires sameness of nomic implications and sameness of nomic enablers. Because the latter notion is expressible in terms of the former (Property A is a nomic enabler with probability p of property B just in case it is a nomic implication of A holding that B holds with probability p), we can focus for the moment just on the notion of nomic implication. There are at least three ways that the notion of nomic implication might be understood. At its broadest, a dated state of affairs B holding with probability p is a nomic implication of a dated state of affairs A just in case the laws of nature ensure that whenever A holds, B holds with probability p. There is no restriction on the temporal order of A and B. Thus, for example, even if the date of A is later than that of B, if it is a law of nature that the only way that A can arise is by B arising, then B is a nomic implication of A. Nomic implications (which may be probabilistic states of

affairs) are, on this construal, the nomically necessary conditions of something holding. Temporal considerations are relevant only to the extent that the laws of nature make them so.

On a narrower construal, nomic implications are restricted to states of affairs that occur after the specified one. This restricted conception of nomic implication captures what we can call nomic powers (to produce future events), but for the purpose of characterizing nomic roles it would be inappropriate to adopt this conception. For it risks ignoring connections that the laws of nature establish. Nomic implications on this construal do not capture any nomic synchronic covariance conditions, for example (e.g., that a certain temperature is nomologically equivalent to a certain mean kinetic energy). Of course nomic enablers on this construal may presumably capture the nomic covariance conditions, so there might be no problem in imposing the temporal constraint on the equipollency conception of nomic role. But there would be no advantage either, since a plausible account will capture all nomic connections—not just ones going in one temporal direction.

A related, but different, sort of restriction on the relevant conception of nomic implication is to restrict implications to causal implications, where these are not understood merely as future-directed nomic implications as above, but as some special kind of nomic connection. The idea is that some properties confer causal powers, and some do not, and the only relevant connections are those involving these causal powers. For example, one might hold that (given specific background assumptions) traveling at 100 kilometers per hour confers certain causal powers, whereas the disjunction, traveling at 100 kilometers per hour or having once accelerated beyond the speed of light, does not confer causal powers—even though the two are (we believe) nomologically equivalent (since the second disjunct is nomologically impossible).

This restricted conception of nomic implication leads to a restricted conception of nomic role. Call it the causal role account. To get this account off the ground requires much stronger assumptions than the unrestricted conception of nomic role that we have been considering so far. For it requires the assumption that there are causal connections that are not capturable in terms of nomic implications. We can grant, of course, that we can distinguish between nomic connections that are between an event and future events (nomic powers as characterized above) and other sorts nomic connections (e.g. synchronic covariances), but the causal role account requires much more. For it claims that nomologically equivalent properties (such as A vs AvB, where B is nomologically impossible) do not always have the same causal powers. But nomological equivalent properties have identical nomic implications and enablers.

Those who believe in universals (properties that are wholly present in their instances) will have little difficulty in accounting for causal connections in this deep sense. For they will simply say that causal connections are nomic connections between universals. A universal may be nomologically equivalent with another property, but if the other property is not a universal, then it confers no causal powers. As indicated above, I am deeply skeptical of universals, and eschew positing them for the nomic role account I am exploring. It may be that we need to posit universals to solve various problems, and if so we will have good reason to deny that natural properties can be characterized solely in terms of the broad nomic role account. But in this paper we are exploring how much we can do without positing universals, and so this route is not open to us.

One could posit causal powers in the above deep sense without positing universals. One could hold that some properties (which need not be wholly present in their instances) have causal powers and some do not. One might hold this view on the grounds that the laws of nature do

more than establish nomic implications in the broad sense. The laws of nature, it might be claimed, also identify which properties have causal powers.[13] Or one might agree that laws only establish nomic connections as characterized above, but hold that there is an independent fact about which properties have causal powers. Either way, this involves a metaphysically problematic assumption. For such accounts require much more than the mere assumption that there are laws of nature that establish nomic connections in the broad sense. Although I am skeptical that there are causal powers over and above nomic connections, I shall not argue that point here. I shall simply examine what sort of account of natural properties can be developed without a strong assumption of causal powers.

3.3 Equipollency Refined

The intuitive idea of the equipollency conception of nomic role is similar in spirit to the idea of a Ramsey sentence corresponding to a predicate. You take a sentence that is true exactly if all the laws of nature are true, replace all occurrences of predicates by predicate variables, and then quantify over the variables to get a sentence that asserts that there exist properties such that the open sentence is true. Nomic roles can be thought of as second order properties of properties: the properties of being such as to make the open sentence, partially quantified, true.

There are two problems with this account of nomic role. One is that it is relative to a particular language (and its primitive vocabulary in particular). The other is that it does not distinguish metaphysically (or conceptually) necessary connections (e.g., that weighing 2 kilograms entails weighing more than 1 kilogram) from metaphysically contingent nomic connections (e.g., that the force of attraction between two objects varies directly with the product

of their masses and inversely with the square of the distance that separates them). For this reason I shall develop a closely related but different account.

To start, let us suppose that the laws of nature are probabilistic. Let p be the conditional nomic probability function. For any dated two states of affairs, S and Q, p(S|Q) is the nomic probability that S will occur given that Q occurs. If the laws of nature are strongly holistic, the probability function may be undefined whenever the conditioning state of affairs (i.e., Q in p(S|Q)) is less than a total state of the world. If, however, the laws of nature have some local pockets of determinacy, then p(S|Q) may be defined even when Q is less than a total state of the world. The rough idea (assuming monadic properties for illustration) is that two properties, A and B, have the same nomic implications just in case, for any dated states of affairs S and Q, and any individual i and time t, p(S|A(i,t)&Q) equals p(S|B(i,t)&Q). (Throughout sameness of probabilities assignments is to be understood to be compatible with both being undefined, but not with only one being undefined.) And A and B have the same nomic enablers just in case, for any dated states of affairs S and Q, and any individual i and time t, p(S&A(i,t)|Q) equals p(S&B(i,t)|Q).

There are two qualifications needed on this account. First, nomic probabilities may not capture all nomic connections. For example, the laws of nature might determine what is nomologically possible, but not determine any probabilities (nomic possibilities without nomic probabilities). Second, even if the laws of nature determine nomic probabilities, if probabilities are restricted to standard (non-infinitesimal) numbers, probability functions cannot represent certain cases of nomic possibility or necessity. For example, if there are an infinite number of equally probable possibilities, a standard probability function must assign a probability of zero (since any positive standard number would result in the probabilities summing to more than one). But this has the result that a nomic probability of zero does not ensure nomic impossibility and a nomic

probability of one does not ensure nomic necessity. Non-standard probability functions (which can have infinitesimal values) can handle this, but since they are somewhat controversial, some may be reluctant to recognize them.

If there are nomic possibilities, but not nomic probabilities, or if nomic probabilities are required to be standard numbers, then nomic probability functions do not capture all nomic connections. The problem, however, is easy to rectify. For in this case we can simply appeal both to nomic conditional probability functions and to nomic conditional possibility functions, where a nomic conditional possibility function, ps, ps(S|Q) takes the value of 1 if it is nomically possible that S given Q, and takes the value 0 if S is nomically impossible given Q. For brevity, I shall focus solely on nomic probability functions, and leave the generalization to nomic possibility functions implicit.

The second qualification needed concerns the condition that two properties have the same nomic role only if they have the same nomic implications and the same nomic enablers. For in the broad sense these depend on nomic probabilities, which depend in part on metaphysical possibilities that have nothing specific to do with the laws of nature. For example, the nomic probability of A(i,t) given A(i,t) is one in all worlds in which there are nomic probabilities. If we require the same nomic probabilities in order to be equipollent, then no incompatible property can be equipollent (since it will have probability of zero, given A(i,t)). But this would be overly restrictive. For there is no reason to exclude the possibility that the laws of nature might treat two incompatible properties exactly the same. The property of having a temperature of exactly 40 degrees Celsius, might, for example, be nomically indistinguishable from having a temperature of 40 plus one trillionth degrees Celsius. But given that the two are incompatible, they cannot have the same nomic probabilities.[14]

In order to handle this problem, the requirement of sameness of nomic implications and of enablers should be restricted to cases where the properties involved are metaphysically independent. More specifically, we shall say that two properties, A and B, are equipollent just in case for all individuals i, times t, and dated states of affairs Q and S, such that neither A(i,t)&Q, nor B(i,t)&Q), metaphysically entails S, or ~S:

1) Sameness of nomic implications: $p(S|A(i,t)\&Q) = p(S|B(i,t)\&Q)$, and

2) Sameness of nomic enablers: $p(A(i,t)\&Q|S) = p(B(i,t)\&Q)|S)$.

With this account equipollency, and thus of nomic role, we can now proceed to give an account of carving reality at its nomic joints.

4. Carving reality at the Joints: Promiscuity, Finickiness, and Contingency

a. Overview

The rough idea of the nomic role account of natural properties is that corresponding to each nomic role there is a property that is neither excessively indeterminate nor excessively determinate relative to that nomic role. Such properties carve reality at its nomic joints and are natural.

To help us focus our thoughts, let's consider a simple model in which the only particulars are points in space, and the only properties are temperatures. To keep things simple, we'll ascribe temperatures to spatial points (as opposed to material objects), and we'll suppose that time and space are each discrete, one dimensional, and Newtonian (non-relativistic). We shall further assume (again for simplicity) that the laws of nature permit only temperatures greater than or equal to 1, and less than 4, degrees Celsius, and that the "next" temperature at a given location is determined by its current temperature. For any integer n, let Tn be the property of having a temperature greater than or equal to n, and less than n+1, degrees Celsius. More specifically, let us

suppose that all and only the consequences of the conjunction of the following two conditions are laws of nature:

(1) everything has either T1, T2, or T3; and

(2) anything having T1 (T2, T3, respectively) at a given time has T2 (T3, T1, respectively) at the next time.

Consider now the property, T2vT4. This property doesn't carve reality at the joints because it is excessively indeterminate relative to the laws of nature in that there is a more determinate (i.e., logically stronger) property that is nomologically equivalent. In particular, because temperatures greater or equal to 4 degrees Celsius are nomologically impossible, T2vT4 is nomologically equivalent to T2 (given the laws of nature, T2vT4 is instantiated when and only when T2 is). Thus, because T4 is nomologically impossible, T2vT4 is excessively indeterminate, and fails to carve reality at the joints.

One way, then, that a property can fail to carve reality at the joints is by being excessively indeterminate, that is, by failing to rule out things that nature rules out (i.e., by being compatible with nomologically impossible properties). Let us call such properties promiscuous. More precisely, call a property promiscuous just in case some metaphysically more determinate (logically stronger) property is nomologically equivalent. Promiscuous properties fail to recognize nature's distinctions between which properties are nomologically possible and which are not. Thus, promiscuous properties are not natural, because they carve up the world more coarsely than nature does.

In the above example, we were dealing only with temperature properties, and so we only had to worry about ruling out nomologically impossible temperatures. But when there are many different kinds of properties—mass properties and velocity properties, for example—a pure mass property will always fail to rule out nomologically impossible pure velocity properties, since pure

mass properties entail nothing about velocities. For the moment let us suppose that properties are partitioned into "natural" families (e.g., mass properties, length properties, etc.), and understand non-promiscuity to require only that nomologically impossible properties in the same family be ruled out. Below I'll question the plausibility of the assumption of natural partitions of properties, and discuss the implications if the assumption is dropped. Making the assumption temporarily will make it easier to present the basic account of carving reality at the joints.

Consider next the property, T#2.0, of having a temperature of exactly 2 degrees Celsius. T#2.0 is excessively determinate in that it is sensitive to features which the laws of nature ignore. For the laws of nature in this example are sensitive to what integral temperature interval is had, but not to the specific temperature in that interval. T#2.0 has exactly the same nomic implications and enablers as T#2.1 (i.e., having a temperature of exactly 2.1 degrees Celsius). Each nomically implies that the next temperature will be T3, and each has T1 as its sole nomic immediately preceding enabler. The two properties are nomically indistinguishable, and thus each is excessively determinate relative to their nomic role.[15]

A second way a property can fail to carve reality at the joints, then, is by being excessively determinate relative to its nomic role. Let us call such properties finicky. More precisely, call a property finicky just in case some distinct non-promiscuous property has the same nomic role. Finicky properties are not natural, because they carve up the world more finely than nature does. Here too let us assume for the moment that properties are naturally partitioned into families, and that non-finickiness only requires that no distinct non-promiscuous property in the same family has the same nomic role. [16] We'll return to this assumption below.

So far, then, we have identified non-promiscuity and non-finickiness as necessary conditions for carving reality at the joints (being natural). A third and final way that a property can fail to

carve reality at the joints is by being nomologically non-contingent, that is, by being either nomologically impossible or nomologically necessary (i.e., being such that the laws of nature ensure either that nothing in the property's domain instantiates it or that everything therein does). Nomologically non-contingent properties (such as that of accelerating past the speed of light, and its negation) do not carve reality at the joints, since they make no distinctions among nomologically possible things.[17]

Here, then, is the nomic role account of carving reality at the joints:

Nomic Joints: A property carves reality at its nomic joints just in case it is nomologically contingent, non-promiscuous, and non-finicky.

Thus, natural properties, on the nomic role account, have exactly the right level of determinacy relative to the laws of nature: they are sufficiently determinate so as to be logically incompatible with nomologically impossible features, and sufficiently indeterminate so as to be logically compatible with any nomologically irrelevant features.

An equivalent characterization of carving reality at its nomic joints is as follows: For any property there are a number of other properties that are nomologically equipollent. Some such equipollent properties may be nomologically equivalent, and some may not be. The totality of the laws of nature, that is, divides properties into equipollency classes, and subdivides these classes into nomological equivalence classes. For each equipollency class of nomologically contingent properties there is, on the nomic role account, at most one property that carves reality at its nomic joints, and it is identified as follows.

For each nomological equivalence class within an equipollency class, take the conjunction of all the properties in the equivalence class. This conjunction is the most determinate property of the nomological equivalence class. It is the only member of the equivalence class that is non-promiscuous. All the other properties in the equivalence class fail to rule out some features that nature rules out (since nature precludes their instantiation without the instantiation of the conjunction).

This yields exactly one non-promiscuous property for each nomological equivalence class within a given equipollency class. If there is more than one nomological equivalence class, then all the non-promiscuous properties are finicky (since they are each more determinate than necessary). Thus, none of the properties having that nomic role will be non-finicky. The disjunction of the selected non-promiscuous properties, however, is non-finicky. For, since the selected non-promiscuous properties make up all the non-promiscuous properties having the specified nomic role, their disjunction abstracts from nomically irrelevant features. [18]

Thus, carving reality at it nomic joints can be recast as follows:

Nomic Joints (recast): A property carves reality at its nomic joints just in case it is (1) nomologically contingent, and (2) it is identical with the disjunction of all conjunctions of all nomologically equivalent properties within a nomologically equipollent class.

This finishes the basic account of natural properties. Natural properties are properties that carve up the world the way nature does. They are neither excessively indeterminate (promiscuous), nor excessively determinate (finicky). The conjunction of all nomologically equivalent properties yields a non-promiscuous property. The disjunction of all equipollent such conjunctions yields a

non-finicky, non-promiscuous property. That property, if nomologically contingent, carves reality at its nomic joints, and is thus natural on the nomic role account.

5. Strengths of the Account

How well does this account of natural properties capture the features that natural properties are supposed to have?

First, natural properties (like properties generally) are not linguistic entities. Their existence does not depend on the existence of any natural language. Furthermore, although all meaningful linguistic predicates of any natural language correspond to properties, not all correspond to natural properties—indeed almost none of them do, since almost all of them are either promiscuous, finicky, or non-contingent. Nor is it true that all natural properties correspond to some linguistic predicate of some existing natural language, since lots of contingent, non-promiscuous, non-finicky properties may not be expressible in the vocabulary of any existing natural language.

Second, all and only those properties that carve reality at the joints in terms of (broad) nomic roles are natural properties. No surprise here. Of course, as indicated above, the notion of carving reality at the joints is sometimes understood in a more restricted causal power sense, and sometimes in the non-nomic, metaphysical sense of making for similarity, and the nomic role account will be assessed negatively below in terms of these other understandings.

Third, in all worlds with substantial laws of nature (i.e., for which some metaphysical possibilities are nomologically impossible), natural properties are logically sparse relative to the class of properties: not all properties are natural properties. In particular, none of the following kinds of properties is natural: (1) the metaphysically universal property (which is instantiated by everything; e.g., being self-identical); (2) the metaphysically null (or impossible) "property" (e.g.,

being non-self-identical); (3) nomologically universal properties (which all nomologically possible things instantiate); and (4) nomologically null properties (which no nomologically possible things instantiates; e.g., accelerating past the speed of light).[19]

In addition, if the laws of nature are robust in a certain way, then the negations of natural properties are not natural. The robustness assumption is that for (any given domain of individuals, and) any natural number n, there is some n-place property which is nomologically null (or impossible) in that the laws of nature ensure that it is never instantiated. Given this assumption, for any given property either it or its negation is promiscuous, since either it or its negation will fail to rule out some nomologically null property of the same adicity. Thus, if a given property is natural, its negation is not.[20]

Fourth, the set of all natural properties of a given world provides the basis for a complete nomic description of the world in the sense that nomic facts supervene nomologically on natural property facts. This is so because non-natural properties are either nomically non-contingent, promiscuous, or finicky, and all such properties supervene on natural properties. Nomically non-contingent properties are either nomically impossible or nomically necessary. The former are identical with the conjunction of any two incompatible natural properties, and the latter are identical with the disjunction of all natural properties. Finicky property facts are either not nomic facts (e.g., that some finicky property is instantiated) or are nomic implications of nomically contingent non-finicky property facts (e.g., that some finicky property nomically might be instantiated given certain circumstances is a nomic implication of the fact that some less determinate non-finicky property nomically will be instantiated in those circumstances). Finally, promiscuous, nomically contingent, non-finicky property facts are nomologically equivalent to non-promiscuous, nomically contingent, non-finicky facts (since their promiscuous aspects have, by definition, no nomological force). So,

the totality of natural properties provides the basis for a complete nomic description of the world. We shall see below, however, that natural properties do not provide the basis for a complete (nomic and non-nomic) description of the world, since non-nomic facts do not supervene on nomic facts.

Fifth, which properties are natural is not knowable a priori, but rather requires empirical investigation, and depends on what the laws of nature are. Knowledge of which properties are natural, that is, requires knowledge of which properties are nomologically equivalent, and which are equipollent. And that requires knowledge of what the laws of nature are, which is not knowable a priori.[21]

The nomic role account of natural properties, then, captures many of the features that natural properties (and universals) are often supposed to have. There are, however, a number of features commonly ascribed to natural properties that the nomic role account fails to capture. Let us consider some specific objections.

6. Objections

One objection to the nomic role account is that it implies that natural properties need not be instantiated—although they do need to be nomologically instantiable (i.e., such that the laws of nature allow them to be instantiated). Although some authors (such as Armstrong 1978 and Lewis 1986) hold that only instantiated properties are natural, other authors (e.g., Tooley 1977, p. 686;, Fales 1990, p. 216, 1993, pp. 134-35; and Mellor 1995, p. 201) recognize nomologically possible, but uninstantiated, natural properties. These latter authors hold that such recognition is necessary in order to account for how laws of nature govern, not merely how existing things behave, but also, how things of various types would behave if they existed. The nomic role account of natural properties agrees. It's true, of course, that the belief in laws governing non-actuals creates some

epistemic problems for those adhering to some form of empiricism. But this is a general problem for beliefs that go beyond the immediately observed, and I won't attempt to solve that one here. Suffice it to note that, although the nomic role account does depart from a common way of thinking about natural properties, there is reasonable disagreement on this issue, and so it doesn't depart from the common way (since there isn't one).

A second objection is that on the nomic role account which properties are natural depends on what the laws of nature are, which can vary from world to world. For, which properties are natural depends on which properties are nomologically equivalent and which are equipollent, and that depends on what the laws of nature are. Given that the laws of nature can vary from world to world, then so can the naturalness of properties. Some may object that the naturalness of a property is not world-relative.[22]

In order to avoid this world-relativity of naturalness, one needs to deny either that the laws of nature differ in some worlds, or that the naturalness of properties depends on what the laws of nature are. Neither denial is possible on the nomic role account. For the nomic role account presupposes that in at least some worlds there are laws of nature that rule out some metaphysically possible states of affairs. But if all worlds have the same laws, then any supposedly ruled out metaphysically possible state of affairs will not be realized in any metaphysically possible world (since it is ruled out in all, if in any), which is a contradiction. So the nomic role account is committed to there being at least two possible worlds with distinct laws of nature. Although the assumption that the laws of nature can vary from world to world is not unanimously endorsed,[23] it is almost unanimously endorsed. And it is clearly endorsed by Armstrong and Tooley. So, I won't bother to defend that assumption.

The assumption that the laws of nature determine what properties are natural is, however, controversial. Some authors hold that natural properties, such as, say, that of having a mass of exactly 2 kilograms, are natural in every world in which they exist, and thus do not depend on what the laws are in those worlds. [24] This view is plausible, if carving reality at the joints is construed as that which makes for (genuine) similarity, but it is not plausible if it is construed in terms of nomic roles. The nomic role account is formally wedded to the laws of nature determining what properties are natural.

So, the nomic role account holds that the naturalness of a given property is world relative, and that goes against a (perhaps the) common view of natural properties.

A third objection is that on the nomic role account natural properties fail to be fundamental in the sense of providing a complete and non-redundant basis for the describing the world. As indicated in the previous section, the set of natural properties on this account provides the basis for a complete nomological description of the world (a description of all nomological connections). It fails, however, to provide a complete description of the world, because it does not provide basis for the description of non-nomic facts. Facts about which of two equipollent properties holds are not capturable in terms of natural properties on the nomic role account. For example, facts about which of two distinct equipollent mental state qualia holds is not so capturable. So natural properties fail to provide a basis for a complete description of the world.[25]

Furthermore, the set of natural properties includes some descriptive redundancies in the sense that some natural properties can be ignored without destroying the descriptive power of the set.[26] This is because, as I will explain, some conjunctions and disjunctions of natural properties are also natural properties on the nomic role account. Obviously, such conjunctions and disjunctions generate descriptive redundancy.

On the nomic role account the disjunction of natural properties is natural as long as it is nomologically contingent. For disjunction preserves both non-promiscuity (since, if each disjunct is incompatible with nomologically impossible properties, so is the disjunction) and non-finickiness (since disjunctions are less determinate).[27] Thus, if T1 and T2 are two distinct natural temperature properties, then so is T1vT2, as long as it is nomologically contingent.

Conjunctions of natural properties may also be natural on the nomic role account. A simple example of this is (T2vT3)&T2, where T2 and T3 are incompatible and each is natural, and T2vT3 is nomological contingent (and thus natural as well). This conjunction is, of course, simply T2. This is a cheap example in that one of the conjuncts entails the other. For a more interesting example of a conjunction of two natural properties also being natural, we need two natural properties addressing different issues, say temperature and barometric pressure. Suppose T2 and P2 are each natural. Then T2&P2 will also be, as long as T2 and P2 are nomologically compatible (so that T2&P2 is nomologically contingent), and no other non-promiscuous property is equipollent (so that T2&P2 is non-finicky). (The non-promiscuousness of T2&P2 is guaranteed by the non-promiscuousness of T2 and of P2.).[28]

So, the nomic role account allows that disjunctions and conjunctions of natural properties are sometimes natural, and thus the account fails to ensure that there is no descriptive redundancy in the set of natural properties. Some (e.g., Tooley 1977), but not all (e.g., Armstrong), deny that the conjunction of two distinct natural properties is ever a natural property. And almost all authors on the subject deny that the disjunction of two distinct natural properties is natural.[29]

The issue here does not presuppose that properties have a privileged definition or a structure (as they do on the fine-grained account). It does not presuppose, that is, that some properties are conjunctive, others disjunctive, and no property is both. It can allow that any given

property is equivalent to some conjunction of properties, and to some disjunction of other properties . The issue here is rather one of definability -- rather than privileged definition (or structure). It concerns whether some natural properties are definable in terms of conjunctions, or disjunctions, of other natural properties . If some natural properties are definable in terms of others, then the set of natural properties includes some descriptive redundancy.

Now, if natural properties are construed as properties that make for similarity, or that provide causal powers, such descriptive redundancy is quite problematic. For then the naturalness of certain disjunctions (e.g., brown-and-a-dog-or-white-and-a cat) will create problems in certain similarity judgements (is the brown dog more similar to the white dog or to the white cat?). And the naturalness of certain disjunctions will create problems for accounts of causal powers (do the causal powers come from A, or from AvB?). But the nomic role account, makes no attempt to account for similarity judgements or causal powers, and thus redundancies are not a problem in these regards.

Still, the general view is that disjunctions of natural properties are not natural, and the nomic role fails to endorse this view. So clearly there will be some descriptive redundancy. But why should we think that nature identifies a minimal set of properties with no redundancies? Of course, as theorists, we are interested in eliminating redundancies, because doing so makes our lives easier (by reducing the number of things that we have to deal with). But we should not confuse our very legitimate interests in non-redundant sets of properties with anything given by nature. Nature is silent on this.

To make the general point more specific, let us suppose that having a mass of 2 kilograms, and having a mass of 4 kilograms are natural properties. On the nomic role account (given some uncontroversial assumptions), so are having a mass of between 2 and 4 kilograms, and having a mass of 2 or 4 kilograms. One might say that surely nature doesn't pay attention to such properties

when it is "pushing things around". But this is not so. There are a lot of things in the world that will break if a mass of 2 or 4 kilograms is placed on them, which won't break if a mass of 1 kilogram is placed on them. Nature is sensitive to this property. Of course, the more determinate the natural property is, the more determinate nature's treatment is, but that doesn't establish that the less determinate properties aren't recognized by nature.

Of course there are subsets of natural properties that contain no redundancies, and we can arbitrarily choose any one of them as our set of primitives. But nature does not impose any particular choice upon us. Suppose, for example, that the set of all natural properties is just {A, B, AvB, and A&B}. We can arbitrarily select {A,B} as the privileged base, but as far as nature is concerned {A, AvB}, or {A, A&B} are equally eligible bases. Each set is expressively complete relative to the set of natural properties. Any natural property, that is, is equivalent to some logical combination (involving negation, conjunction, and/or disjunction) of elements in the privileged set. As far as nature is concerned each base is just as good.

On the nomic role account, then, there are no fundamental properties in the sense of there being a uniquely metaphysically privileged descriptively complete and non-redundant set of properties. Even the similarity and causal power accounts of naturalness may face this problem. For, as Sider (1995) has argued, if there are no atomic properties (of similarity or causal powers), then there will have to be some redundancy (e.g., if, for any P, P is identical to Q&R for some Q and R, where Q and R each provide grounds for similarity or causal powers).[30]

A fourth objection to the nomic role account is that it gives no account of causal powers that goes beyond nomic powers. Nomic powers, recall, are the nomic implications concerning future state of affairs. If A is nomologically impossible, then for any property B, AvB, is nomologically equivalent to B, and they have the same nomic powers. But those who believe in causal powers

hold that at most one of them has causal powers. They hold that the other is just epiphenomenal. Now the nomic role account of natural properties holds that AvB is not natural, on the grounds that it is promiscuous, but it makes no claim that the real powers reside with B (or perhaps elsewhere). To see this more clearly, consider a second example. Suppose that T1 and T2 (two temperature properties, say) are each natural on the nomic role account, but not equipollent. Then T1vT2 is also natural, as long as it is nomically contingent. T1, and T1vT2, have different nomic powers (since they have different nomic implications for the future), but neither is taken to be the real source of nomic powers.[31]

So the nomic role account gives no account of causal powers. Although some will view this as a major defect, those who are suspicious of the very idea of causal powers (but not of nomic implications) will find this silence appropriate.

A fifth objection to the nomic role account is that it provides no account of making for similarity or for projectibility. First of all, it allows that non-intrinsic properties (those the having of which is dependent on whether there are other objects in the world) can be natural.[32] For example, the property of having a mass of 5 kg or being within a mile of the something with a mass of 10 kg could be natural. For it has various nomic implications and enablers, could be nomically contingent, non-promiscuous, and non-finicky. But similarity, at least on the usual construals, is determined solely by intrinsic properties. Second, even the intrinsic natural properties on the nomic role account fail to provide a basis for similarity judgements. If Green and Blue are each natural properties, then so is Green-or-Blue as long as it is nomically contingent. (All three are intrinsic.) So, on the nomic role account there is no way of making greenness, but not greenness-or blueness, the basis for similarity judgements.

It would indeed be nice to have a clear account of the basis for similarity judgements, and the nomic role account of natural properties offers no help.[33] Closely related to this point, natural properties on the nomic role account need not be projectible in the sense that historical regularities involving them may reasonably be expected to continue. Grueness (e.g., green and first examined before year 2000 or blue and first examined on or after year 2000) might be a natural property on the nomic role account. Grueness has nomic connections. It has, for example all the nomic implications common to both greenness and blueness. It is both contingent and non-promiscuous, and if the laws of nature are sensitive to greenness and blueness in a certain way, it will be non-finicky as well. So grueness may be a natural property.

We all want to deny honorific status to this detestable property and its dirty companions, but it's not clear that we may do so legitimately. Of course, if there are universals, or at least objectively privileged properties that make for similarity, then a solution to the grueness problem is at hand. But, given that the existence of universals or such properties is controversial, the naturalness of grueness may need to be tolerated.

A sixth and final objection to the nomic role account is that the usual sorts of determinates—mass, temperature, and the like—are not natural properties, if properties are not naturally partitioned into families. In my discussion of promiscuity and finickiness I assumed, for simplicity, that properties are naturally partitioned into families (e.g., mass properties, velocity properties, etc.), and that the conditions for non-promiscuity and non-finickiness were relative to a property's family. Promiscuity was defined as excessive indeterminacy relative to the family of which the property is a member. Thus, failure to rule out nomologically impossible velocities (if there are any) does not make a mass property promiscuous. It is only failure to rule out

nomologically impossible mass properties (if there are any) that makes a mass property promiscuous.

Without the assumption that properties are naturally partitioned into families, however, almost any property we consider will be promiscuous. For almost every property fails to rule out nomologically impossible features that it does not address. Having a particular mass does not, for example, rule out nomologically impossible velocities, if there are any. So, without the assumption of natural partitions, the nomic role account classifies almost every property we might consider as non-natural.

It is time to address the assumption that properties are "naturally" partitioned into families. One possibility is that properties are so partitioned and the partition is objective (mind-independent). If that is the case, then no revision is needed to the account. I doubt, however, that properties come with tags identifying a unique issue which they are presumed to address. Of course, for magnitudes (i.e., properties which ascribe numerical measures of some feature; e.g. temperature ascriptions) it seems that there is a uniquely relevant family of properties dealing with the same issue. For a given temperature property, for example, the uniquely relevant family of properties seems to be the family of all temperatures properties. But what reason do we have to suppose that this family is objectively given? For although we would almost always fix upon that family as the relevant one, this is, it seems, something fixed by our interests, and not by the property itself. There are an infinite number of ways of partitioning properties into families. The partition that places all and only temperature properties in the same family is just one partition among many. A different partition might have all mass-temperature properties in one family. And so on. And when one considers non-magnitude properties (such as being a rock), the existence of a uniquely

privileged family of properties (other than the family of all properties) becomes much more dubious.[34]

Another possibility is that properties are so partitioned, but the partitions are imposed by our cognitive structure. Here too no revision is needed to the account, but it would need to be understood that the naturalness of properties was not a purely mind-independent matter. Even this possibility, however, seems doubtful. For although for some properties (e.g. magnitudes such as mass properties) may have natural cognitively determined families, this is doubtful for many properties. What is the cognitively natural family to which the property of being a rock belongs?

If I am wrong, and properties do come naturally partitioned into families, then the nomic role account of carving reality at the joints avoids the problem of judging a mass property non-natural simply because it fails to rule out certain nomologically impossible velocity properties. If properties are not naturally partitioned into families, however, then the notions of promiscuity (excessive indeterminacy) and finickiness (excessive determinacy), and therefore naturalness, must be based on appeals to all properties and not merely to properties in the same family. (Alternatively, we could take the natural partition to be the trivial one of putting everything in the same family.) And so understood, most of the properties we typically pick out will fail to be natural, since they will be promiscuous (because they fail to rule out nomologically impossible features that they do not address).

If there is no natural (non-trivial) partition of properties into families, then we must accept that all the properties that we typically refer to are promiscuous, and that, of course, conflicts radically with the common view about what is natural. This implication is not particularly surprising. For the common view presupposes that properties are naturally partitioned into families. Once that assumption is rejected, our views about what is natural will need to be radically revised.

Of course, we can always assess the naturalness relative to a specified family of properties. Having a certain mass may be natural relative to the family of mass properties, but not relative to the family of mass-velocity properties. But this doesn't help much, since our interest is in a notion of naturalness that is non-relative, or perhaps relative to the partition fixed by our cognitive structures.

The lack of a natural partition of properties does not make the nomic role account of naturalness incoherent or empty. It still judges some properties to carve reality at the joints and thus to be natural. It's just that these properties will be rather different from our usual sorts of properties. They will be limited to properties that are the nomological restriction of some property, where this is the most determinate nomologically equivalent property (i.e., the conjunction of it and all nomologically equivalent properties). If , for example, there are only mass and velocity properties, and the only nomologically possible pure mass and pure velocity properties are M1-M3, and V1-V3, respectively, then the nomological restriction of M1 is M1& (V1vV2vV3), and the nomological restriction of V2 is V2&(M1vM2vM3). Only properties that are nomological restrictions of some property are non-promiscuous, and thus natural. Such properties are natural if they are also nomologically contingent and non-finicky.

So, if there is no natural partition of properties, then questions about whether a given property is natural are, on the nomic role account, best interpreted as questions about whether the nomological restriction of the property is natural. Although the failure to classify some of our "normal" properties as natural is a serious shortcoming of the nomic role account, the problem can be mitigated somewhat by appealing to questions about the naturalness of nomological restrictions.

7. Conclusion

Natural properties carve reality at the joints, but in the literature there are at least three conceptions of carving reality at the joints: making for similarity, providing causal powers, and having the appropriate level of determinacy relative to the laws of nature. I have developed and assessed an account of naturalness of the last sort. I haven't argued against the other two conceptions, although I have expressed some doubts about the very strong presuppositions that they require.

On the nomic role account natural properties are nomologically contingent, non-promiscuous, non-finicky properties. This account captures a significant number of, but not all, the features that natural properties (and universals) are presumed to have. In particular, it ensures that natural properties are sparse, that which properties are natural is not knowable a priori, and that the totality of natural properties provide the basis for a complete nomological description of the world.

The nomic role account, however, does not even attempt to capture the mysterious notion being "wholly present in its instances as a non-spatio-temporal part". And it has the following features to which some will object. It allows that some uninstantiated but nomologically instantiable properties, and that some disjunctions and some conjunctions of natural properties, are natural. It does not ensure that the set of natural properties is descriptively complete or that it has no descriptive redundancy. It does not provide an account of causal powers, similarity, or projectibility. Finally, on the nomic role account, the usual determinates (exactly specified masses, etc.) are not natural (although their nomological restrictions may be).

More generally, the nomic role account does not rise to David Lewis's challenge of new work for natural properties (and universals). It does not provide new resources for accounts of similarity, for causality, for reference, or for projectibility. For natural properties on the nomic role account are not additional laborers available to do new work. They are rather laborers already on

staff (viz. properties). The nomic role account of naturalness is simply a new and useful way of categorizing these laborers. This categorization has the merit of distinguishing the promiscuous and the finicky from their more natural brethren. But it adds nothing to the labor force.

Now, it may be that, in order to get some important work done (e.g., solving problems concerning reference, causation, projectibility, and similarity), we will need to posit more than properties and laws of nature. We may need to posit, for example, universals understood as properties that are wholly present as non-spatio-temporal parts in their instances. Although I am skeptical that this is so, I have done little in this paper to cast doubt on the existence of universals. I have merely explored an account of natural properties that makes no appeal to universals.

The nomic role account has the general merit of presupposing only realism about the laws of nature and about properties generally, and of making natural properties quite non-mysterious once those presuppositions are accepted. The weakness of the presuppositions, of course, greatly limits the tasks that can be accomplished. The plausibility of the nomic role account thus depends on which of the tasks should be rejected as unachievable, which can be accomplished by other legitimate means, and which require stronger metaphysical assumptions about properties (e.g., that some make for similarity or confer causal powers). If stronger assumptions about properties are legitimate, then the nomic role account is inadequate. Without stronger assumptions, however, it would seem to be the best account of the carving reality at the joints, and thus of naturalness.[35]

Department of Philosophy

Virginia Commonwealth University

Richmond, Virginia 23284-2025

REFERENCES

Achinstein, P.: 1974, "The Identity of Properties", American Philosophical Quarterly 11, 257-75.

Armstrong, D.: 1978, A Theory of Universals, Cambridge University Press, Cambridge.

Armstrong, D.: 1983, What is a Law of Nature, Cambridge University Press, Cambridge.

Armstrong, D.: 1989, Universals: An Opinionated Introduction, Westview Press, Boulder.

Bacon, J.: 1986, "Armstrong's Theory of Properties", Australasian Journal of Philosophy, 64, 47-53.

Bacon, J.: 1995, Universals and Property Instances: The Alphabet of Being, Basil Blackwell, Oxford.

Bealer, G.: 1982, Quality and Concept, Oxford University Press, Oxford.

Bigelow, R., and Pargetter, R.: 1990, Science and Necessity, Cambridge University Press, New York.

Dretske, F.: 1977, "Laws of Nature", Philosophy of Science, 44, 248-68.

Dupre, J.: 1993, The Disorder of Things : Metaphysical Foundations of The Disunity of Science, Harvard University Press, Cambridge, Mass.

Elder, C. L.: 1992, "An Epistemological Defense of Realism About Necessity", The Philosophical Quarterly, 42, 317-36.

Elder, C.L.: 1994, "Realism and Determinable Properties", unpublished, University of Connecticut.

Elgin, C.Z.: 1995, "Unnatural Science", Journal of Philosophy, 92, 289-302.

Fales, E.: 1990, Causation and Universals, Routledge, New York.

Fales, E.: 1993, "Are Causal Laws Contingent?", in Ontology, Causality, and the Mind: Essays in Honour of D.M. Armstrong, J. Bacon, K. Campbell, and L. Reinhardt (eds.), Cambridge University Press, New York, 121-44.

Fodor, J.: 1991, "A Modal Argument for Narrow Content", Journal of Philosophy, 86, 5-26.

Forrest, P.: 1993, "Just Like Quarks? The Status of Repeatables", in Ontology, Causality, and the Mind: Essays in Honour of D.M. Armstrong, J. Bacon, K. Campbell, and L. Reinhardt (eds.), Cambridge University Press, New York, 45-65.

Hirsch, E.: 1993, Dividing Reality, Oxford University Press, New York.

Lewis, D.: 1983, New Work for a Theory of Universals", Australasian Journal of Philosophy 61, 343-77.

Lewis, D.: 1986a, On the Plurality of Worlds, Basil Blackwell, Oxford.

Lewis, D.: 1986b, "Against Structural Universals", Australasian Journal of Philosophy, 64, 25-46.

Madden E. H., and R. Harré: 1975, Causal Powers: A Theory of Natural Necessity, Basil Blackwell, Oxford.

McCall, S.: 1994, A Model of the Universe, Oxford University Press, New York.

Mellor, D.H.: 1980, "Necessities and Universals in Natural Laws", in Matters of Metaphysics, D.H. Mellor (ed.), Cambridge University Press, Cambridge, 136-53.

Mellor, D. H.: 1991, "Properties and Predicates", in Matters of Metaphysics, D.H. Mellor (ed.), Cambridge, 170-82.

Mellor, D. H.: 1993, "Reply", in Ontology, Causality, and the Mind: Essays in Honour of D.M. Armstrong, J. Bacon, K. Campbell, and L. Reinhardt (eds.), Cambridge University Press, New York.

Mellor, D. H.: 1995, The Facts of Causation, Cambridge University, Cambridge.

Mellor, D. H. and A. Oliver, (eds.): 1997, Properties, Oxford University Press, Oxford.

Mortensen, C.: 1987, "Arguing for Universals", Revue Internationale de Philosophie, 41, 97-111.

Mundy, B.: 1987, "The Metaphysics of Quantity", Philosophical Studies, 51, 29-54.

Oddie, G.: 1991, "Supervenience and Higher-Order Universals", Australasian Journal of Philosophy, 69, 20-47.

Oliver, A.: 1996, "The Metaphysics of Properties", Mind, 105, 1-80.

Owens, D.: 1989, "Disjunctive Laws?", Analysis, 49, 197-202.

Putnam, H.: 1970, "On Properties", in Mathematics, Matter, and Method, Hilary Putnam (ed.), Cambridge University Press, Cambridge, 305-22.

Robinson, D.: 1993, "Epiphenomenalism, Laws, and Properties", Philosophical Studies, 69, 1-34.

Seager, W.: 1991, "Disjunctive Laws and Supervenience", Analysis, 51, 93-98.

Shoemaker, S.: 1980a, "Properties and Inductive Projectibility", in Applications of Inductive Logic, L. J. Cohen, and M. Hesse (eds.), Clarendon Press, Oxford, 293-332.

Shoemaker, S.: 1980b, "Causality and Properties", in Time and Cause, P. van Inwagen (ed.), D. Reidel, Dordrecht, 109-35.

Shoemaker, S.: 1988, "On What There Are", Philosophical Topics, 16, 201-23.

Sider, T.: 1994, "Two Conceptions of Primitive Naturalness", unpublished, University of Rochester.

Sider, T.: 1996, "Intrinsic Properties", Philosophical Studies, 83, 1-27.

Sider, T.: 1995, "Sparseness, Immanence, and Naturalness", Nous, 29, 360-377.

Sober, E.: 1982, "Why Logically Equivalent Predicates May Pick Out Different Properties", American Philosophical Quarterly, 19, 183-89.

Swoyer, C.: 1982, "The Nature of Natural Laws", Australasian Journal of Philosophy, 60, 203-23.

Swoyer, C.: 1987, "The Metaphysics of Measurement", Measurement, Realism, and Objectivity, J. Forge (ed.), D. Reidel, Dordrecht.

Swoyer, C.: 1993, "Logic and the Empirical Conception of Properties", Philosophical Topics, 21, 199-231.

Swoyer, C.: 1996, "Theories of Properties: From Plenitude to Paucity", Philosophical Perspectives, 10, 243-64.

Taylor, B.: 1993, "On Natural Properties in Metaphysics", Mind, 102, 81-100.

Tooley, M.: 1977, "The Nature of Laws", Canadian Journal of Philosophy, 7, 667-98.

Vallentyne, P.: 1988, "Explicating Lawhood", Philosophy of Science, 55, 598-613.

Vallentyne, P.: 1997, "Intrinsic Properties Defined", Philosophical Studies, 88, 209-219.

Wilson, M.: 1982, "Predicate Meets Property", The Philosophical Review, 91, 549-89.

Wilson, M.: 1985, "What is This Thing Called "Pain"?", Pacific Philosophical Quarterly, 66, 227-67.

Wilson, R.: 1992, "Individualism, Causal Powers, and Explanation", Philosophical Studies, 68, 103-39.

Wilson, R.: 1993, "Against A Priori Arguments for Individualism", Pacific Philosophical Quarterly, 74, 60-79.

Yablo, S.: 1991a, "Mental Causation", The Philosophical Review, 101, 245-80.

Yablo, S.: 1992b, "Cause and Essence", Synthese, 93, 403-49.

Department of Philosophy

Virginia Commonwealth University

Richmond, VA 23284-2025

U.S.A.

Notes

[1] One of the best accounts of carving reality in terms of metaphysical similarity is Hirsch 1993.

[2] Some of the most comprehensive recent works on properties and natural properties are Armstrong 1978 and 1989, Bacon 1995, Bealer 1989, Fales 1990, Hirsch 1993, Lewis 1983, Mellor 1995, and Oliver 1996. Many of the most important papers on properties have been collected in Mellor and Oliver, eds. 1997. In addition to the works cited below, see also Mellor 1980, Sober 1982, Wilson 1982 and 1985, Nelson 1985, Bigelow and Pargetter 1990, Swoyer 1987, 1993, and 1996, and Taylor 1993.

[3] For enlightening discussion of fine-grained properties, see Lewis 1986b, pp. 55-59.

[4] Note that natural properties (e.g., having a specified temperature on many accounts) are typically not natural kinds where these are understood so that each individual instantiates exactly one natural kind, or so that natural kinds are essential (necessarily had) by the individuals that instantiate them.

[5] For simplicity, I will typically write as if the only laws of a world are the laws of nature of the sort that science studies. In principle, however, the proposed account is compatible with there being other sorts of laws as well (e.g., moral). Thus, strictly speaking, the account gives rise to a narrow account of naturalness (relative to scientific laws only) and a broad account (relative to all laws).

[6] Here and below compatibility with the laws of nature should not be confused with the stronger notion of compatibility with the laws and some given state of affairs (e.g., initial state). Being on some distant planet at time t is compatible with the laws nature, but it is not compatible with the

laws of nature and being on planet Earth at time t', if t and t' are too close together (given the maximum travel speed).

[7] See Vallentyne 1988. A similar account (which differs in some important details) is given by McCall 1994

[8] The first three, and possibly the fourth, of the following accounts presuppose the independent identification of natural properties : David Lewis 1983, Tooley 1977, Armstrong 1983, and Dretske 1977.

[9] This is very roughly the view that Hilary Putnam once articulated (but only to set aside). See Putnam 1970. I mistakenly endorsed this view in a footnote of Vallentyne 1988.

[10] For discussions relevant to the difference between equipollency and equipotency, see the contrast between causal properties and causal powers in Wilson 1992, and the contrast between powers and liabilities in ch. 5 of Madden and Harre 1995. Although much of Sydney Shoemaker's writing on natural properties appeals to equipotency, he recognizes the need for something like equipollency. See, for example, Shoemaker 1980a (p.297), the note added in proof of Shoemaker 1980b, and Shoemaker 1988. Finally, those who hold that the identity of natural properties is specified by the Ramsey sentence of the correct complete theory of nature hold the equipollency conception (or something similar). One clear proponent of this view is Mellor (1991, pp. 173-5, 181; 1995, pp. 192-196).

[11] This is clearly the most common view. It is implicit, for example, in the work of Armstrong (e.g., 1978, p. 43). It is quite explicit in Shoemaker 1980a and 1980b, in Achinstein 1974, and in Swoyer 1982. See also Fodor 1991, p. 5 and Fales 1990, p. 211. Although the language of these

authors is in terms of the equipotency view, I suspect that many of them would endorse the equipollency view, once the difference is pointed out.

[12] One might wonder whether we could ever distinguish between equipollent properties. An example might be two distinct but equipollent mental state qualia. In any case, the point of my discussion does not require that equipollent properties be distinguishable by us.

[13] Shoemaker (1980a, 1980b, and most explicitly in 1988) views natural properties as those that have causal powers (and not merely nomic connections in the broad sense), but he takes the naturalness of properties and nomic connections as primitive, and identifies causal connections as nomic connections between natural properties. For insightful discussion of accounts identifying natural properties on the basis of their causal connections versus their nomic connections, see Hirsch 1993 (pp. 61-65).

[14] Here I am building upon the discussion by Fodor (1991) of the irrelevance of conceptual implications for the identification of casual powers.

[15] Isn't there a difference in the sorts of thermometer readings that they lead to? Not in the very simple model under consideration - since there are not any thermometer reading properties . And even if there were thermometer reading properties, there might be nomological limits to the distinctions that thermometers and thermometer readers could register.

[16] My appeal to non-promiscuity and non-finickiness is loosely related to Yablo's (1992b) appeal to leaving out too many relevant factors or bringing in too many irrelevant ones. An important difference is that he is developing an account of causation whereas I am developing an account of nomic role.

[17] Actually, this restriction to nomologically contingent properties could be dropped with no significant effect. It would simply mean that two additional properties would be classified as natural: the property of being nomologically possible, and the property of being nomologically impossible. Assuming that there are some laws of nature, the property of being metaphysically possible would remain non-natural because it is promiscuous, and the property of being metaphysically impossible would remain non-natural because it is finicky.

[18] The disjunction of all the non-promiscuous properties in an equipollency class is not itself a member of the equipollency class whenever there is more than one such member. For example, in the example, the disjunction of all the equipollent properties in T#1.0's equipollency class, namely T1, is not a member of that class. This is because, although T1 has the same nomic implications as T#1.0, it does not have the same nomic enablers (since T1 follows T3 with nomic certainty, but T#1.0 does not). This is a reflection of the fact that collapsing irrelevant distinctions (as in the disjunction that is T1) does not necessarily preserve facts about nomic enablers.

[19] Armstrong (1978) endorses each of these claims.

[20] Note that if there are no laws of nature, then all properties are equipollent, there are no promiscuous properties, and all properties are finicky. Thus, none is natural.

[21] Again, Armstrong (1978) endorses this claim.

[22] See, for example, Lewis 1986, pp. 60-61, and Hirsch 1993, p.63.

[23] One dissenter is Swoyer 1982.

[24] See, Armstrong 1983, pp. 139-40, and Lewis 1986a, p. 60, fn. 44.

[25] I am indebted to Michael Tooley for pointing this out and for the example.

[26] Armstrong (1978, p. 117), Lewis (1983, p. 346; 1986, p. 60), and Oddie (1991, p. 21) each ascribe non-redundancy to natural properties.

[27] One way of attempting to avoid holding that disjunctions of natural properties are ever natural is to deny that there are any laws involving disjunctions. Both Owens (1989) and Seager (1991) present arguments for this denial by rightly pointing out that evidence (e.g., that a 6 was not rolled on a die) that confirms a hypothesis (e.g., that a 1 was rolled) need not confirm the disjunction of this hypothesis with another (e.g., that a 1 or a 6 was rolled). They conclude that, since laws are the sorts of things that are confirmable by their instances, lawhood is not closed under entailment (and thus not all the logical consequences, such as weakenings with disjunctions, of laws are laws). I reject this approach because I reject any epistemic conception of laws. Laws are the regularities imposed by nature, and so the interesting epistemic point about confirmability is irrelevant to the question of what regularities are imposed.

[28] Although some disjunctions and conjunctions of natural properties are natural, not all are. Cheap examples are where the disjunction is nomologically necessary, or the conjunction is nomologically impossible. Examples can also be developed where the disjunction, or conjunction, of two natural properties is finicky, and thus non-natural.

[29] Mellor (1993, pp. 179-181; 1995, pp. 197-199) denies that negations, conjunctions, and disjunctions of natural properties are natural. A closely related claim is the claim that determinables (as opposed to determinates) are not natural properties. This claim is rejected by Fales (1990, ch.9) and by Elder 1994.

[30] For related doubts about the existence of a privileged set of descriptively non-redundant properties, see Dupre 1993, Yablo 1992, Elgin 1995, and Taylor 1993.

[31] For further discussion of how "gimmicky" properties have nomic connections, see Shoemaker 1988 (pp. 215-217) and Hirsch 1993 (pp. 61-65).

[32] Giving an adequate account of intrinsicness is no easy task. See, for example, Lewis 1986a (pp. 60-63), Lewis 1983, Sider 1996 and Vallentyne 1997.

[33] See Hirsch 1993 (pp. 56-61) for a defense of an objective notion of similarity.

[34] For more optimistic views, see Elder 1992, Swoyer 1987, and Mundy 1987.

[35] Work on this paper was funded in part by fellowship grant from the American Council of Learned Societies. I've benefited from comments and criticisms from John Bacon, George Bealer, John Carroll, Crawford Elder, Tony Ellis, Gary Hardcastle, John Heil, Mark Hinchley, Brad Hooker, Hugh Mellor, Brian McPherson, Trenton Merricks, Eugene Mills, Graham Oddie, Alex Oliver, Jacob Pinnolis, Ted Sider, Chris Swoyer, Michael Tooley, Stephen Yablo, Robert Wilson, and several anonymous referees.