

NATURAL PROPERTIES AND THE SPECIAL SCIENCES: NONREDUCTIVE PHYSICALISM WITHOUT LEVELS OF REALITY OR MULTIPLE REALIZABILITY

In this paper, I investigate how different views about the vertical and horizontal structure of reality affect the debate between reductive and nonreductive physicalism. This debate is commonly assumed to hinge on whether there are high-level, special-science properties that are distinct from low-level physical properties and whether the alleged multiple realizability of high-level properties establishes this. I defend a metaphysical interpretation of nonreductive physicalism in the absence of both of these assumptions. Adopting an independently motivated, discipline-relative account of natural properties and appealing to a phenomenon I call “multiple determinativity,” in which a single physical property simultaneously realizes different kinds of special-science properties, is sufficient to show that some special-science properties are irreducible to physical properties and that nonreductive physicalism is not merely a terminological variant of reductive physicalism.

For roughly the past forty years, discussions of reductive and nonreductive physicalism have centered on a number of related debates, including the nature and extent of multiple realizability (MR) and whether the MR of a property grounds its irreducibility (e.g., Putnam 1967; Lewis 1969/1980; Fodor 1974; Kim 1998; Shapiro 2000; Gillett 2003). These debates have commonly been articulated against the background assumption that there is a “vertical” structure of reality. For instance, Jaegwon Kim writes:

For much of [the twentieth] century, a layered picture of the world . . . has formed a constant—tacitly assumed if not explicitly stated—backdrop for debates on a variety of issues in metaphysics and philosophy of science—for example, reduction and reductionism, the mind-body problem, emergence, the status of the special sciences, and the possibility of a unified science. (1998, 16)

As Kim also notes, “sometimes the layered model is couched in terms of concepts and languages rather than entities and their properties” (ibid.).

Indeed, some philosophers have voiced skepticism about the existence of metaphysical levels in nature. They argue that levels make sense only when applied to our conceptual schemes or theories and not to the world itself (e.g., Heil 2003).¹

Assuming, as Kim seems to, that the debate between reductive physicalism (RP) and nonreductive physicalism (NRP) is a debate about levels, if there are no objective, context-independent metaphysical levels of reality, then this would seem to support the idea that the differences between RP and NRP, if any, are exclusively epistemic or conceptual. Other philosophers have been led to endorse a merely “epistemic” interpretation of NRP, largely in response to the “disjunctive property” objection to the multiple realizability argument, which I discuss in Section 4. So, there are at least two reasonable lines of thought that seem to undermine the claim that there is a metaphysical (or at least an objective, nonanthropocentric) difference between RP and NRP.² I suspect that these lines of thought are connected. They both depend on an assumption about the nature of the “horizontal” structure of reality: that the naturalness of natural properties is not relative to, and is completely independent of, explanatory practices and interests.

I believe that there are good reasons to reject purely epistemic interpretations of NRP. For one thing, it is not clear that they succeed in making NRP out to be a genuine competitor to RP. Reasonable reductive physicalists will also admit that nonphysical concepts are necessary for some human projects. The debate between RP and NRP should hinge on *why* this is the case: is it merely a pragmatic or anthropocentric fact resulting from our cognitive capacities, or is it instead grounded in objective features of the world?

Of course, one could defend the claim that there is a metaphysical difference between RP and NRP by defending either the multiple realizability argument or the idea that there are metaphysical levels of reality. I will adopt an alternative strategy in this paper: I explore whether one can defend the claim that the difference between RP and NRP is partly a metaphysical one without relying on levels of reality or multiple realizability. In doing so, I argue for two main claims. First, the notion of a *natural property* that is relevant to the debate between RP and NRP is one according to which the naturalness of a property is relative to some scientific discipline or other. Second, this notion of natural property allows one to defend NRP without appealing to multiple realizability or to levels of reality.

In Section 1, I make some preliminary comments about levels of reality and natural properties. In Section 2, I discuss the alleged mind independence of natural properties and introduce a plausible realist view about natural properties according to which they can be mind independent in the relevant sense even if their naturalness is relative to our explanatory interests. In Section 3, I explore the relation between this interpretation of mind independence and another characteristic of natural properties: that they can be individuated by the causal powers they contribute (at least in worlds with the same causal generalizations). Namely, the account of natural properties from Section 2 supports a discipline-relative unity condition on the sets of causal powers that correspond to natural properties. After showing that a stronger “absolute” unity condition implies that multiple realizability is necessary for the irreducibility of a property, in Section 4 I discuss the “disjunctive property” objection to the multiple realizability argument and argue that the epistemic interpretation of NRP (mentioned above) is an unsatisfactory response. Then, in Section 5, I show how the discipline-relative account of natural properties defended in Sections 2 and 3 can be used to respond to the disjunctive property strategy. Finally, I argue that a little-noticed phenomenon I call *multiple determinativity* (in which single physical property simultaneously realizes different kinds of special science properties) shows that this response, and the account of natural properties it is based on, remains grounded in the objective (but not necessarily layered) causal structure of the world.

1. Levels of Reality and Natural Properties

Assuming that the idea of multiple levels of reality is coherent, it seems that we could interpret the debate between RP and NRP as simply a disagreement about whether there are high-level properties that are distinct from low-level physical properties. However, as mentioned above, philosophers such as John Heil (2003) have raised doubts about the cogency of the multiple levels view, claiming that it depends on a misguided “picture theory” of language. Further, even if some sense can be made of levels of reality, they may turn out to lack features that are crucial for grounding the debate between RP and NRP. For instance, levels of reality may be “local” (not “monolithic”) so that it makes no sense to ask if, say, neural properties are at a lower level than psychological properties *in general* (cf. Craver 2007, 190–92). In this paper, I accept such skeptical worries about the

coherence of general levels of reality, and ask how the distinction between RP and NRP should be drawn in their absence.

In other work (Haug forthcoming a), I have argued that this debate is best understood as being about *natural* properties. In short, the debate turns on a fundamental disagreement about whether there is a single set of properties that can fulfill all of the roles attributed to natural properties. This paper elaborates on that proposal. In order for this interpretation to yield an objective, metaphysical difference between RP and NRP, facts about natural properties must be, in some sense, mind independent. A variety of antirealist and constructivist views about natural properties have denied this. Thus, if the argument in this paper is to be successful, these broadly constructivist views must be false.

Of course, I do not intend to show that all constructivist views of natural properties are false, which would clearly be too large a task for a single paper. Rather, I plan to show that the way in which natural properties are mind independent, according to a plausible naturalistic realist account of them, can be used to draw a metaphysical distinction between RP and NRP.

2. *The Mind Independence of Natural Properties*

2.1. *Constitutive Independence: Instantiation and Classification*

Bird and Tobin (2009) note that the mind independence of natural properties is a consequence of standard scientific realism, which holds that the reality described by scientific theories is largely independent of our thoughts or theoretical commitments.³ Natural properties mark out classifications that are privileged by nature, those that are, in some sense, fixed by the world and not by us. Not just any way of classifying entities has this privileged status; only natural properties “carve nature at its pre-existing joints.” Those who deny the mind independence of natural properties hold that they are in some sense constructed, rather than discovered, by our activities. However, there are at least three different ways in which constructivists have held that natural properties (and scientific facts) are metaphysically dependent on human mental and social activity: *material*, *causal*, and *constitutive* dependence (cf. Kukla 2000, ch. 3). It is only *constitutive* dependence that is relevant to debates about realism. (The former are examples of what Jenkins (2005) and Miller (2010) call “mundane” dependence.)

Constitutive independence seems to have two dimensions.⁴ First, there is a dimension that concerns *instantiation*, according to which the fact that things instantiate property P is independent of our mental states. I believe that this is best construed as the following claim:

*Instantiation Independence: what it is for things to have property P is independent of mental states, linguistic practices, and conceptual schemes.*⁵

Second, there is a *classificatory* dimension according to which a property P is “not merely a division artificially imposed on the world by human concepts” (Thomasson 2003, 583). In other words, if a property is constitutively independent, it has “natural boundaries,” which are “independent of the acceptance of beliefs about the nature” of that property (ibid.). I follow Thomasson in claiming that this dimension of independence holds when the following two principles are true:

Ignorance Principle: “for all conditions determining the nature of property P, it is possible that these remain unknown to everyone.” (ibid.)

Error Principle: “any beliefs (or principles accepted) regarding the nature of Ps could [for all we know] turn out to be massively wrong.” (ibid.)

Construed as above, if a property is independent along the *instantiation* dimension, then it is also independent along the *classificatory* dimension. If *what it is* for something to have property P is completely independent of our beliefs and practices, then it is possible for us to be wrong or completely ignorant about the nature of P.⁶ (In other words, it is impossible for an object’s having property P to be completely independent of us while at the same time we necessarily have some true beliefs about the conditions determining the nature of P.) However, the converse claim need not hold. In particular, it will not hold when P is a mental property like *believing that Q*. Even if the ignorance and error principles hold (as might be the case if functionalism is true about mental properties), what it is for me to *believe that Q* will not be independent of human beliefs: trivially, it is dependent on the fact that I believe that Q (cf. Miller 2010). However, this kind of trivial instantiation dependence is uninteresting; any property instantiation is trivially dependent on itself in this way. If, as

seems plausible, the only cases in which *classificatory* independence does not entail *instantiation* independence involve this sort of triviality,⁷ then the two dimensions of constitutive independence amount to the same thing (at least if instantiation independence is construed “essentially” and not modally; see note 6). In any case, since classificatory independence is the kind of constitutive independence that is relevant to realism about allegedly natural *mental* properties, unless otherwise noted, I will use the term ‘constitutive independence’ to pick out *classificatory* independence in what follows.

If natural properties are constitutively independent of our representational capacities and social practices, then those capacities and practices will be “metaphysically innocent” in an important sense. Richard Boyd (e.g., 1991; 1999) has offered a sophisticated realist account of natural properties that captures this idea while claiming that the naturalness of a property is relative to a scientific discipline. In the remainder of this section, I’ll outline Boyd’s account of natural properties and show that the discipline relativity of natural properties does not undermine their constitutive independence.⁸

2.2. *Constitutive Independence and Discipline Relativity*

The core of Boyd’s account, the accommodation thesis, is “intended to capture the basic *realist* element in the naturalist realist conception of natural [properties]” (Boyd 1999, 55, italics in original):

Accommodation Thesis: the naturalness of natural properties “consists in a certain *accommodation* between the relevant conceptual and classificatory practices and *independently existing* causal structures.” (ibid., italics in original)

It follows from this thesis “that the naturalness of a natural [property] depends on the inferential architecture within which representations of it are embedded” (ibid., 57). Thus,

the fundamental notion in the theory of theoretical natural [properties] is not the notion of such a [property], *simpliciter*, but instead the notion of a [property]’s being natural with respect to a particular *inferential architecture* At least in the case of natural [properties] in the sciences, that inferential architecture can best be thought of as being provided by a *disciplinary*

matrix: a family of inductive and explanatory aims and practices, together with the conceptual resources and vocabulary within which they are implemented. (ibid., italics in original)

Boyd, of course, borrows the term ‘disciplinary matrix’ from Thomas Kuhn, who proposed it as a replacement for one of the two main uses of the term ‘paradigm’ in his ([1962] 1996). According to Kuhn, a disciplinary matrix is a group of “shared elements” that “account for the relative fulness [sic] of . . . professional communication and for the relative unanimity of . . . professional judgments” within a scientific discipline (ibid., 182). Kuhn claims that symbolic generalizations, models, exemplars (the replacement term for the second main sense of ‘paradigm’), and values are among the elements of a disciplinary matrix (ibid., 184f.). The inductive and explanatory aims that Boyd mentions are clearly examples of disciplinary values. (Kuhn cites predictive accuracy and a preference for quantitative over qualitative predictions as examples of values (ibid., 185).) Some values may be unique to a particular discipline. For example, systematics is concerned with elucidating historical-phylogenetic relationships (and with corresponding natural properties like *being an insect*), whereas parasitology is concerned with discovering ecological relationships (and with corresponding natural properties like *being a parasite* and *being a host*) (cf. Khalidi 1998, 42). What values and aims exist and how they should be grouped to help explain disciplinary coherence is partly an empirical question. For example, disciplinary aims can overlap and converge or diverge over time, which likely plays a role in the emergence of new scientific disciplines, like biochemistry and behavioral economics. Importantly, the accommodation thesis does not assume that disciplines, or the properties they study, can be organized into levels.

An extensive exploration of disciplinary matrices is beyond the scope of this paper, and for our purposes one need not endorse all of the details of Kuhn’s discussion. Boyd’s account of natural properties requires only a minimal notion of disciplinary matrix, according to which it includes inductive, explanatory, and practical goals and the practices and resources used in attempting to achieve those goals. Given this understanding of a disciplinary matrix, accommodation can be understood as follows.

Accommodation is the fit between, on the one hand, a matrix’s conceptual and classificatory resources and, on the other, relevant causal

structures in the world required to achieve the goals of that matrix (cf. Boyd 1999, 57). The classificatory resources of a disciplinary matrix contribute to accommodation insofar as they neither gloss over causal similarities relevant to the matrix's goals nor introduce causal information irrelevant to those goals.

The accommodation thesis has two notable implications. First, it implies that the claim that natural properties are *constitutively independent* can be formulated in terms of what Boyd calls the *No Noncausal Contribution* (2N2C) thesis: human mental activity and social practices make no noncausal contribution to the causal structures of the phenomena scientists study (Boyd 1991, 173). Second, and more importantly for our purposes, the accommodation thesis “commends to us the terminology of philosophers who speak, for example, of psychological [properties] like pain being natural [properties] ‘from the point of view of psychology’ but not (owing to multiple realizability, for example) ‘from the point of view of basic physics’” (Boyd 1999, 57).

We can capture this notion of naturalness as follows:

A property P is perfectly natural relative to disciplinary matrix M if and only if reference to P provides (or would provide) maximal accommodation between M and the relevant causal structures in the world.

Boyd claims that accommodation is explained by our “epistemic access” to the relevant causal structures (i.e., the tendency for our terms for natural properties to be used to make claims that are approximately true of objects that have those properties) together with the causal powers of the things that have those properties (Boyd 1999, 58). So, a *maximally* accommodated matrix will incorporate inductive and explanatory generalizations that are true (simpliciter) and employ classificatory resources that perfectly track the relevant causal structures.

Since it is likely that few, if any, actual scientific disciplines are maximally accommodated, it is helpful to have a comparative notion of naturalness. To a first approximation (ignoring, for example, complications concerning partial denotation):

A property P is more natural than property Q relative to disciplinary matrix M if and only if reference to P better contributes to the ac-

commodation between M and the (relevant causal structures in the) world than reference to Q does.

Note that even though the naturalness of a property is relative to mental states like interests and goals, this is perfectly compatible with constitutive independence. This kind of interest-relativity obtains only because, as I discuss further in Section 5, different aspects of the world's causal structure are relevant to the satisfaction of the explanatory interests of (say) psychology than are relevant to the satisfaction of the interests of physics. Our interests, in effect, merely single out different independently existing causal structures; they do not constitute, or determine the boundaries of, those structures. In other words, the boundaries of natural properties are independent of our beliefs about their nature of those properties. Thus, *classificatory* independence still holds for such properties. Further, with respect to *instantiation* independence, what it is to have a natural property is still independent of our beliefs and practices, even though *the fact that that property is natural* is not independent of the beliefs and practices that are central to the accommodation of a particular matrix.⁹

In the remainder of the paper, I will use this account of natural properties to argue that some special-science properties are natural and not identical to natural physical properties, even if the former are not multiple realizable and are not at a higher level than the latter.

3. Natural Properties and Unity Conditions on Causal Powers

Natural properties are those that contribute causal powers to objects that possess them. As Kim points out, “current debates about the mind-body problem and mental causation presuppose . . . [that] differences in properties must reflect differences in causal powers” (1998, 105). At least in worlds with the same causal laws and generalizations, if property P is not identical to property Q, then P contributes different causal powers than Q, and if P is identical to Q, then P and Q always contribute the same powers. So, at least in worlds with the same causal generalizations, each natural property P can be uniquely matched up with a *causal profile*, the set of causal powers that P contributes to individuals that possess it. (I do not assume a full-blown causal theory of properties according to which the causal powers contributed by a property are *essential* to that property.)

However, not just any set of causal powers will be a causal profile. We need to identify “unity conditions” that distinguish sets of causal powers

that are causal profiles of natural properties from those that are not. Shoemaker suggests the following necessary condition for unity: a set of causal powers corresponds to a property only if it is closed under “nomic and metaphysical entailment—that for every power contained in the set, the set contains every power nomically or metaphysically entailed by that power” (2001, 87). However, as Shoemaker grants, this condition is not sufficient for unity, for it does not rule out “phony” properties formed from arbitrary disjunctions of natural properties.¹⁰

Further, I think that *absolute* closure under nomic and metaphysical entailment is too strong to be necessary for unity. If properties are natural only relative to a disciplinary matrix, then we should incorporate this point into the unity conditions as follows.

Relative closure: A set of causal powers corresponds to a natural property of kind K ¹¹ only if it is closed under nomic and metaphysical entailment with respect to causal powers that are directly relevant to the accommodation of disciplinary matrix K .

Another way of seeing that Shoemaker’s proposed necessary condition for unity may be too strong (at least if the discussion in Sections 4 and 5 is correct) is that it has the consequence that a realized property must be *multiply* realizable in order to be irreducible. Under the “absolute closure” condition, unless a realized property is multiply realizable, it cannot correspond to a set of causal powers that is closed under nomic entailment and distinct from the causal profile of its realizer. For instance, suppose *being in pain* is initially associated with a set of causal powers A (which may be definitive of *being in pain* on some functionalist accounts), and suppose it has a nomically unique realizer P , associated with a set of causal powers B . On Shoemaker’s (2001) “subset” account of realization, since P realizes *being in pain*, A is a subset of B .¹² However, any object that has a causal power in A nomically must have every power in the set B/A , since it is nomically impossible for an object to be in pain but lack P . Thus, A is not closed under nomic entailment and hence does not correspond to a property. We have just a single property here, $P = \textit{being in pain}$, corresponding to the set of powers, B .

Thus, if we adopted Shoemaker’s necessary unity condition and *the multiple realizability argument failed*, defenders of NRP could not claim that realized mental properties are irreducible to physical properties. The

best defenders of NRP could hope for is that their view differs epistemically—or conceptually—from RP. However, as I discuss in the next section, this is an unacceptable result.

4. *The Multiple Realizability Argument Vs. the Disjunctive Property Strategy*

Here is one formulation of the multiple realizability argument for the claim that mental properties are irreducible (i.e., not identical) to physical properties:

- (1) If mental property M is reducible, then there is some natural, physical property P such that necessarily, for all x , Mx iff Px . (“General” or “uniform” property reduction is a necessary condition for reducibility.)
- (2) For any natural, physical property P that realizes M , it is possible for some individual to lack P but have M , since some other natural, physical property, Q , could realize M . (M is multiply realizable.)
- (3) The disjunctive property, $P \vee Q$, is not a natural physical property.
- (4) So, there is no natural physical property P such that necessarily, Mx iff Px .
- (5) So, M is irreducible.

The disjunctive property response challenges premise (3) in this argument. According to this response, there is a natural physical property that realizes M (namely, the disjunction of all of the possible nondisjunctive total realizers of M , which I denote by ‘ $\vee P_i$ ’) for which it holds that necessarily, for all x , Mx iff $\vee P_i x$. (See Shoemaker (1981) on the distinction between total and core realizers. Only total realizers are plausible candidates for reductive identities, so, unless otherwise noted, all realizers discussed in this paper should be taken to be total realizers.) With the threat of multiple realizability neutralized, the idea is that this lawlike correlation can be easily “enhanced” into a property identity (see Kim 1998, 97).

For years, many defenders of NRP followed Hilary Putnam and Jerry Fodor in thinking that the disjunctive strategy could be dismissed as a nonstarter since all merely disjunctive properties (like *being a raven or a*

writing desk) were supposedly “wildly heterogeneous,” unprojectible, and (hence) non-natural. However, as Kim (1998; 1999) has argued, this claim poses an apparent problem for NRP. Given that any multiply realizable property is necessarily coextensive with the disjunction of its possible realizers, *if* the disjunctive property is unnatural and unprojectible, then it seems that the multiply realizable property is as well.

In response to this problem, there is a growing trend of admitting that some disjunctive properties are natural (cf. Clapp 2001, Shoemaker 2007). What becomes of NRP, if one grants that the multiple realizability argument does not demonstrate that mental properties are distinct from physical properties? Given that, according to this view, there is in principle some complicated physical predicate that can denote any property currently denoted only by a mental predicate, what reason do we have to think that mental predicates cannot be replaced wholesale by physical predicates? Clapp suggests that we adopt a

... weaker version of NRP [that] does not deny that it is in principle possible for “ideal” scientists to formulate physicalistic predicates that would reduce our mentalistic predicates. . . . It rather claims that we really shall not and cannot [in practice] reduce our mentalistic predicates to physicalistic predicates. (2001, 135)

Clapp claims that this weak version of NRP “suggests that the nonreducibility of mentalistic predicates is purely due to *our own* epistemological limitations” (ibid., italics added); we can formulate neither infinite disjunctive predicates nor the complicated individual physical disjuncts (ibid., 134; see also Antony 1999, 15). However, as Clapp himself notes, there is a real worry that weak NRP is a “purely epistemological and thus uninteresting doctrine” (2001, 135).

I take it Clapp’s worry is that the basis for weak NRP is entirely anthropocentric: a fact about us, not about the world. Moreover, the *difference* between weak NRP and RP seems to be uninteresting (or nonexistent); weak NRP simply collapses into plausible versions of RP. For instance, in a series of papers and books, Jaegwon Kim (e.g., 1998; 1999) argues that there are no special-science properties distinct from physical properties. (Kim is probably best interpreted as adopting a “local reduction” strategy, which denies premise (1) in the MR argument.) However, he of course admits that mental *concepts* or *predicates* are distinct from physical ones,

and he admits that these mental concepts “may play a practically indispensable role in *our* discourse, both ordinary and scientific” (1999, 17, italics added; see also Kim 1998, 104–5).

Thus, if we make NRP out to be a purely anthropocentric epistemic doctrine, it is indistinguishable from a plausible version of RP.¹³ To remain a distinctive, substantive position, NRP must maintain a slightly modified version of a claim that Fodor makes in “Special Sciences”: “there are special sciences not [solely] because of the nature of our epistemic relation to the world, but [in part] because of the way the world is put together: not all natural [properties] . . . are, or correspond to, physical natural [properties]” (1974, 113). The next section develops a novel argument for this claim.

5. *Relative Closure, Discipline Relativity, and Multiple Determinativity*

5.1. *A Response to the Disjunctive Property Strategy*

Suppose that some mental property, say, *being in pain*, is uniquely realizable by a disjunctive physical property, $\vee P_i$. According to weak NRP and the “absolute closure” unity condition, there is a single property here, a single causal profile, picked out by two predicates: “. . . is in pain” and “. . . is $\vee P_i$.” A defender of NRP might want to insist that only the psychological predicate is projectible and attempt to use this to draw a metaphysical conclusion (cf. Antony 1999).¹⁴ However, the superior projectibility of the psychological *predicate* seems to derive simply from the fact that the physical predicate is too complicated for creatures like us to formulate and use. One might wonder how the physical predicate could be objectively inferior to the mental predicate, given that they are necessarily coextensive.

If we instead adopt the *relative closure* unity condition that is motivated by the discipline-relative account of natural properties, we can say the following about such cases. There is a single natural property here, and it can, in principle, be picked out by a disjunctive physical predicate. However, it is a natural *psychological* property, *not* a natural physical property, because it is natural *only* relative to the disciplinary matrix of psychology. All of the causal powers in the intersection of the causal profiles of the disjunct physical realizers (i.e., the powers in the causal profile of *being in pain*) are powers that are directly relevant only to the explanatory interests of *psychology*, and this intersection of powers is the *only* one that is closed under nomic and metaphysical entailment with respect to some scientific

discipline (or even closed simpliciter, cf. Clapp [2001, 129ff.]; Shoemaker [2001, 87–88]). Reductive physicalism is false in this case because the single property is *not* natural relative to the disciplinary matrix of physics.

Yet someone might object that this doesn't help, for it *seems* that the considerations in the previous paragraph are based solely on how properties are represented. The alleged fact that the property is a natural psychological one still seems to be entirely dependent on *our* explanatory interests and practices. Put another way, adopting the *relative closure* condition results in a hyperintensional condition on property identity. So, why isn't the distinction between RP and NRP still entirely epistemic or semantic? (See notes 10 and 15.)

In response, we should remember that even though adopting the relative closure condition implies that natural properties are hyperintensional entities, it also implies that they are *not* individuated as finely as Fregean concepts or linguistic predicates (i.e., in terms of cognitive significance or synonymy). For, according to the accommodation thesis that motivates the *relative closure* condition, differences in natural properties must still reflect differences in the objective, causal structure of the world. In the next section, I argue that a phenomenon I call 'multiple determinativity' indicates that the world's causal structure is such that, in some cases, special-science properties are distinct from physical properties even when the former are uniquely realizable by the latter.

5.2. Multiple Determinativity

The multiple realizability argument claims that physical properties cannot capture all of the causal similarities in the world. If we replace a multiply realizable mental property with any of its individual physical realizers, say X or Y, then we miss out on a common feature shared by organisms that have X and those that have Y. If the disjunctive property strategy is effective, it blocks this criticism: the disjunctive physical property captures all of the causal similarities that the mental property does. Even so, the disjunctive property (or *any* realizer of a uniquely realizable special science property) may still be insensitive to causal distinctions that are made by special-science properties. It may thus introduce causal information that is *irrelevant* to *any single* special-science point of view. Such a physical realizer will not be as natural, relative to that special-science discipline, as the realized property.

The claim that special-science properties may make distinctions not made by a particular physical realizer should not be interpreted as a violation of supervenience. NRP is a physicalist view, so it cannot countenance special-science differences without physical differences. I am not making a modal claim. Rather, I am referring to cases in which a single complex physical property simultaneously realizes *several different kinds* of special science property, that is, when a single physical property is *multiply determinative*.¹⁵

Examples of multiple determinativity appear to be widespread in the special sciences. For instance, one popular theory of the origin of insect wings is that they evolved from appendages whose original function was thermoregulation (Lewin 1985). Given this evolutionary history, it is likely that a complicated micro-based physical property of a dragonfly's wing simultaneously realizes *being a thermoregulator* and *being an airfoil*.¹⁶ Or, consider a sample of gold, which has a high electrical and thermal conductance, ductility, and a distinctive luster. These properties are all realized by a complicated micro-based property of the gold sample, the core realizer of which is the cloud of free electrons that permeates the metal (see Menzies 1988 for this example). Ecological and phylogenetic properties also provide cases of multiple determinativity. For instance, a complicated micro-based physical property instantiated in a flea realizes both *being a parasite* and *being an insect* (see Khalidi 1998).

Importantly for NRP, many total physical realizers of psychological properties are likely multiply determinative. Consider the property of *being in acute pain*. Since the 1960s, great strides have been made in our understanding of the nociceptive system in humans. Pain processing appears to occur in parallel in a plastic, bilateral system activating neurons in the cerebellum, anterior cingulate cortex, insula, thalamus, ventral premotor cortex, and prefrontal cortex, among other areas (cf. Coghill et al. 1999). These findings strongly suggest that if we have a plausible candidate for a physical property that is a total realizer of *being in acute pain*, it is likely that this property will also be a total realizer for distinct kinds of psychological and neurological properties concerning affect, motor control, attention, memory consolidation, and myelination, most of which will not be conscious and all of which are not easily picked out in everyday language (rough descriptions might include: *being highly vigilant* and *having myelinated neurons firing*).¹⁷ The sets of powers cor-

responding to these properties will satisfy the relative closure unity condition. For example, the set of powers corresponding to *being highly vigilant* will be closed (under nomic and metaphysical entailment) with respect to powers directly relevant to the explanatory interests of cognitive psychology, while the set of powers corresponding to *having myelinated neurons firing* will be closed with respect to powers directly relevant to the explanatory interests of neurophysiology (bioelectrical activity, the chemical properties of membranes, etc.).

Multiple determinativity allows us to see that special-science properties may provide for superior accommodation between our inductive practices and the world's causal structure *even when they are uniquely realizable*. For instance, citing the (by hypothesis) unique realizer *P* of *being in acute pain* in an explanation is equivalent to citing the disjunction of all the properties that are realized by it: *being in acute pain* along with, e.g., *having myelinated neurons firing*.¹⁸ This is *not* due merely to how the realizer is represented since the causal profiles of each of its realized properties are distinct subsets of the causal profile of the single realizer.¹⁹ If we want to explain an effect that is characteristic of pain (wincing, moaning, etc.), an explanation that cites the realizer will be objectively worse because its causal profile literally includes all of the irrelevant causal powers of the other special-science properties (such as *having myelinated neurons firing*). By contrast, by citing *being in acute pain* we single out only those causal powers that are directly relevant to wincing or moaning. The same point will hold for other behaviors (like an organism's reduced activity) and psychological states (such as fear) whose explanation is a goal that is part of the disciplinary matrix of psychology (or a relevant subdiscipline). Thus, *being in acute pain* better accommodates this psychological disciplinary matrix than its total physical realizer does. Hence, *being in acute pain* is more natural relative to this matrix than the total physical realizer (which, again, is the only plausible candidate for type-identity in this case).

Of course, *being in acute pain*, and other folk psychological properties, may also fail to be *perfectly* natural with respect to, say, cognitive psychology. However, if the above argument is on the right track, it is *more* natural than its physical realizer relative to this matrix. Thus, cognitive psychology is likely to be better accommodated if psychologists focus on refining the classificatory resources associated with, and gener-

alizations involving, *being in acute pain* rather than pursuing generalizations and explanations involving physical properties.

One might also have the opposite worry: that it is too *easy* on this account to find perfectly natural properties that are distinct from natural physical properties since all that is required is that we find *some* distinct set of things to be explained.²⁰ I think that three things can be said in response. First, the naturalness of a property is relative to *successful* explanation, so not just any set of proposed explananda will serve to individuate a natural property. Some explanatory goals are simply misguided. Second, a natural property is one that provides for the accommodation of an entire matrix, which is characterized by an interrelated suite of explanatory goals and interests. Hence, a few isolated explananda or a set of unrelated explananda will not be sufficient to play the required role in characterizing natural properties. Finally, and closely related to the previous point, I think that it is plausible that one of the goals of science is not merely to discover truths, but to discover *significant* truths, where the significance of a claim is determined by its role in the project of trying to understand nature (cf. Kitcher 1992, 102ff.). If something like this view is correct, not even any old set of *successful* explanatory practices will be sufficient to contribute to characterizing a natural property.²¹

Another objection alleges that the above discussion of multiple determinativity is mistaken because it focuses on a realizer type that is too broad. According to this response, one can isolate some components of the total realizer that are relevant to the realization of *being in acute pain* but not to the realization of any other property. The crucial case to investigate is whether “minimal realizers” of many special-science properties will be multiply determinative. On the “subset” account of realization (e.g., Shoemaker 2001), this amounts to requiring that a given multiply determinative realizer be associated with a causal profile such that no proper subset of this profile corresponds to a property that realizes the given special-science property. If the minimal realizer of *being in acute pain* involves A δ -fibers firing, then it will be multiply determinative, since it will also realize *having myelinated neurons firing*. I think that there is good reason to think that the minimal realizers of many other special-science properties will also be multiply determinative. Multiply determinative realizers involve complex interactions between different kinds of physical components that ground a suite of qualitatively novel properties that appear together as a “package deal” and are not produced (in a particular

case) by any simpler combination of those components. Because of these interactions, we cannot simply single out physical components of the realizers that are directly relevant to the instantiation of certain of these properties but not others, as we can when the realized properties are *macro-physical* ones like *having mass of 10kg*.

The fact that some special-science properties are more natural than physical properties, relative to some disciplinary matrix, explains why physical properties sometimes fail to accommodate our explanatory projects to the causal structure of the world. Contra reductionists, e.g., Kim (1989), special-science explanations may be “deeper” and “theoretically more fecund” than physical explanations because they isolate causal interactions in which physical realizers enter that are relevant to a given explananda from those that are irrelevant. The explanation in terms of the realizer may contain *more* information since it realizes many properties and plays a role in a corresponding number of sets of causal interactions, but not all of this information is relevant to the (say) mental or behavioral explananda at issue. Physical properties and causal powers are unable to distinguish between the many different sets of special-science causal interactions in which the realizer participates; information regarding these causal interactions thus gets garbled at the physical level. In short, physical properties sometimes conflate distinct causal patterns.

6. Concluding Remarks

On the view of natural properties presented in this paper, a natural mental property may be necessarily coextensive with, but not numerically identical to, a multiply determinative natural physical property (although, as implied by the arguments above, in this case the natural physical property will not be a *disjunctive physical* property). The former will be natural relative to the point of view of, say, cognitive psychology, while the latter will be natural relative to the point of view of physics. Each will play an essential role in meeting the accommodation demands of the relevant discipline that the other cannot play. The phenomenon of multiple determinativity allows us to see that, even in such cases, natural special-science properties continue to map metaphysically distinguished “joints” in nature. To be a natural property relative to discipline K, a property must neither gloss over causal similarities relevant to K nor introduce causal information irrelevant to K. When K is a special science, multiply determinative physical realizers fail on the latter score.

If the discussion in this paper is correct, the nonreductive physicalist need not claim that mental and physical properties belong to different metaphysical levels. She merely needs to establish parity between some special-science properties and physical properties—to show that some special-science properties satisfy the criteria that legitimate physical properties as natural.

Moving beyond cases of multiple realizability and investigating cases of multiple determinativity promises to provide a more accurate picture of the complicated relations between the sciences and between the properties they study. Both the view that all of psychological theory can be carried out with complete disregard for the findings of the physical sciences and the view that psychological theory will be uniformly eliminated in favor of, or reduced to, physical theory are too simplistic. Further, we have seen no reason to think that *any* special science can be developed without paying some heed to underlying physical constraints. From any physicalist perspective, there will be an overarching interest of ensuring that our theories form a mutually consistent and coherent view of the world. Among other things, this will involve exploring how mental properties and causal powers are grounded in physical ones. However, even if some interests of the special sciences coalesce with the interests of physics, sometimes the gain in precision effected by replacing special-science properties with physical properties will not compensate for the loss of simplicity, generalizability, and fecundity (cf. Funkhouser 2006, 564–65). And of course, some interests of each special science will likely always complement, rather than compete with, those of other disciplines. As long as humans continue to have an interest in limning the myriad causal patterns in the world—ecological, social, and psychological—the corresponding special sciences will continue to thrive.²²

Matthew C. Haug

*The College of William & Mary,
Williamsburg, Virginia*

NOTES

1. Heil grants that there are levels ordered by the part/whole relation, but he denies that there are levels of properties that apply to one and the same entity (what Kim [1998] calls ‘orders’). These are the kind of levels that are most relevant to debates about irre-

ducibility and mental causation. In what follows, I use the phrase ‘levels of reality’ to refer to this kind of level.

2. I characterize this paper as defending a *metaphysical* contrast between RP and NRP since it is opposed to views that claim that the contrast is merely *epistemic*. However, as I discuss below (especially in Section 4), the views to which my arguments are chiefly directed are perhaps better characterized as claiming that the difference between RP and NRP is merely *anthropocentric*. On the account of natural properties I employ in this paper, the naturalness of a property is relative to a set of explanatory interests and goals. Consequently, some may balk at calling the conclusion that some natural mental properties are distinct from natural physical properties “metaphysical.” Although I think such hesitation is misguided, I will be satisfied if I have shown that the distinction between RP and NRP is not entirely anthropocentric and that in some cases natural mental properties succeed in capturing features of the objective structure of the world that are missed by natural physical properties. See Section 5. Thanks to Neal Tognazzini for discussion of this issue.

3. Minimal realism about natural properties need not be rejected by all opponents of scientific realism (such as logical empiricists or constructive empiricists). Such empiricists are skeptical of the existence of unobservable natural properties (or of our ability to track them). Insofar as they are skeptical of the “metaphysical” claims of realists, they rationally reconstruct scientific practices that seemingly essentially rely on unobservable natural properties. However, empiricists need not be (and generally are not) skeptical about the mind independence of *observable* natural properties. See (Boyd 1991, 164ff.) for further discussion.

4. The following paragraph draws heavily on Thomasson (2003) and Jenkins (2005).

5. Jenkins (2005) provides some arguments that this kind of *essential* interpretation of (this dimension of) constitutive independence is preferable to a *modal* interpretation (viz., that there is a possible world where property P is instantiated even though there are no mental states whatsoever).

6. If *instantiation* is interpreted modally (see note 5), then this conditional need not be true. As Thomasson points out, it is possible for there to be “artificially gerrymandered” properties “with boundaries solely determined by what conditions we accept [i.e., for classificatory independence to fail], but which conditions nonetheless can be fulfilled even in worlds with no mental states [i.e., for instantiation independence, construed modally, to hold]” (2003, 584).

7. Cf. Thomasson: “The reason both institutional and artifactual kinds lack natural boundaries has to do with the specific [nontrivial] form of [instantiation] dependence on mental states exhibited by these kinds, namely that [their instantiation] depend[s] on certain people accepting principles about *the nature of the kind itself* . . .” (2003, 605; italics in original, my underlining).

8. Boyd writes of natural *kinds* rather than natural properties, but it is clear that he follows Quine in allowing that, say, *yellowness* and *having negative charge* are natural kinds. Thus, Boyd uses the term ‘natural kind’ in the broad way in which I am using ‘natural property.’ However, I will not rely on his account of natural kinds as homeostatic property clusters, in this paper.

9. Since the *naturalness* of a scientific natural property is relative to a disciplinary matrix, naturalness itself is not an intrinsic feature of natural properties (at least if we take intrinsic properties to be nonrelational). As Brian Weatherston (2008) argues, the intrinsic/extrinsic contrast latches on to at least three distinctions: relational/nonrelational, qualitative/nonqualitative, and interior/exterior. Two necessarily co-extensive properties can differ in whether they are relational (like *being square* and *being square or being such*

that the number 2 is even). So, if extrinsicness and intrinsicness (interpreted as being relational or not, respectively) are to be properties of properties, properties must be hyperintensional entities. (More on this below.)

10. Suppose that we are given natural properties C_i and E_i ($i = 1, \dots, n$) that meet the unity condition given above and are such that each C_i is nomically related to each E_i . We can then define arbitrary disjunctive properties, $C = C_1 \vee C_2 \vee \dots \vee C_n$ and $E = E_1 \vee E_2 \vee \dots \vee E_n$, so that C and E will stand in lawlike relations to one another (cf. Antony 1999, 8). Further, since the C_i s and E_i s will figure in many other causal regularities, by disjoining the predicates involved in these regularities with those involved in still others we can construct a network of law-like connections between a variety of what are intuitively pseudoproperties (see Shoemaker 2007, 80ff.). By definition, the sets of causal powers corresponding to C and E will be closed under nomic and metaphysical entailment (assuming that powers like “the power to produce an instantiation of E ” are legitimate); however, they are unprojectible and hence unnatural.

11. That is, a property that is natural relative to disciplinary matrix K .

12. A similar claim holds on other accounts of realization (e.g., Gillett 2002), so I think this conclusion does not turn on the account of realization one adopts.

13. Cf. Fodor: “Presumably, the reductivist answer [to why there are autonomous special sciences] must be *entirely* epistemological. If only physical particles weren’t so small (if only brains were on the *outside*, where one can get a look at them), *then* we would do physics instead of paleontology” (1974, 113, italics in original). In (Haug, forthcoming b), I argue that even if the defender of NRP is forced to go “purely epistemic,” she still can identify objective, nonanthropocentric reasons to prefer NRP to RP.

14. Antony admits that the MR arguments “do *not* establish the metaphysical point that mental properties are distinct from any physical properties, [but] they *do* establish an *epistemological* point about what modes of description are and are not practicable within human epistemic enterprise. [However], we will see that the fact that mentalistic description is humanly useful can, on its own, effectively establish the [metaphysical] autonomy of the mental” (1999, 9). However, all of Antony’s arguments that disjunctive physical predicates are not projectible appeal to *our* epistemic limitations (ibid., 15). These arguments cohere with Antony’s claim that “the question of reducibility should be construed as a partially semantic, partially epistemological question, rather than as an ontological question” (ibid., 18), which is somewhat in tension with the first quotation.

15. As I have argued in Haug (2010), physical realizers may be multiply determinative only if special-science properties are *not* related to their physical realizers in exactly the way that determinables are related to determinates. I also argue in that paper that this necessary condition is satisfied. If this is correct, then natural properties need not form a nonoverlapping hierarchy (as Khalidi 1998 also argues). Several authors have discussed relations that are similar to multiple determinativity: e.g., Menzies (1988), Gasper (1992), and Endicott (1994). However, these relations are either too general or differ from multiple determinativity in important ways. E.g., Endicott’s “constructive plasticity” is simply the phenomenon of a single core realizer realizing incompatible properties when embedded in different total realizers.

16. A micro-based property is the property of having proper parts that are propertied and related in certain ways. I follow Kim (1998) in thinking that the total neurological and biochemical realizers of mental states of an organism will be micro-based properties of that organism. Below, I refer to these proper parts (and their properties and relations) as *components* of the micro-based realizer.

17. An anonymous referee expressed skepticism about whether the relevant total realizer of *being in acute pain* would also be a total realizer of these other properties. I should point out that I have made no attempt to specify this total realizer in great detail. Even indulging the philosopher's conceit that it is something as simple as *having A δ -fibers firing in a nervous system of the appropriate kind*, this will certainly be a total realizer of *having myelinated neurons firing* (since A δ -fibers are myelinated). Further, given that the total realizer of *being in acute pain* includes properties of the anterior cingulate cortex, primary somatosensory cortex, and ventral premotor cortex that are involved in attentional processing (Coghill et al. 1999, 1939), it is plausible that it is also a total realizer of (something like) *being highly vigilant* (although the *core* realizer for this realized property will be different, of course).

18. On this general point, see Gasper (1992, 668–69).

19. Thanks to an anonymous referee for prompting me to clarify this. Of course, this claim will hold only for accounts of property realization that include a subset constraint on causal profiles. However, a similar claim will hold for other accounts of realization.

20. Thanks to an anonymous referee for raising this concern.

21. A complete response to this issue would require a more extensive discussion. However, I am open to there being more natural properties than one might have initially thought, so long as the triviality worry is avoided, for which the considerations mentioned above seem sufficient.

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