DISJUNCTIVE PROPERTIES: MULTIPLE REALIZATIONS*

There has been much debate concerning the status of "disjunctive properties," and much of the debate is fueled by attacks and defenses of *nonreductive physicalism* (NRP). The most prevalent argument in support of NRP, the multiple realizability argument, is standardly thought to stand or fall depending upon the legitimacy of such properties. John Heil[1] presents this standard line of thought as follows:

> We unhesitatingly ascribe mental states across species, despite large differences in underlying physiology. Even within our own species, it seems unlikely that particular mental characteristics are invariably realized in identical neural structures.
>   Multiple realizability, however, need not deter a determined identity theorist [that is, reductionist]. It is open for such a theorist, for instance, to argue that the relevant...characteristic is, in fact, disjunctive in character. That is, it might be that, in you, mental feature M is realized in neural structure N, whereas in an octopus, M is realized in a different sort of neural structure N'. Would this undermine type identity? It would not, unless we assume that M [could] not be identical with the disjunctive characteristic $<N$ or $N'>$ (*ibid.*, p. 64).

If there were legitimate disjunctive properties, the argument from multiple realizability would not refute reductionism. Hence advo-

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cates of NRP argue that there are no disjunctive properties, or that they are in some way illegitimate.[2] Contrary to this standard line of thought, I shall argue that there is good reason to grant the existence and legitimacy of disjunctive properties, and I shall sketch an account of such properties. Yet I shall also argue that the existence and legitimacy of disjunctive properties is compatible with a robust, anti-eliminativist, version of NRP, a version of NRP that ought to satisfy psychologists and philosophers of mind (and economists, biologists, and the like).

I. NRP, THE ARGUMENT FROM MULTIPLE REALIZABILITY, AND THE DISJUNCTIVE STRATEGY

NRP is defined as the conjunction of two theses:

Physicalism: all particulars are constituted by physical particulars, and all properties are realized by physical properties.[3]

Nonreducibility: mentalistic predicates cannot be reduced by physicalistic predicates.

Before the argument from multiple realizability in support of NRP can be presented, some clarifying remarks concerning these theses are in order. To clarify the thesis of physicalism, one must specify what it is for particulars (be they objects or events) and properties to be *physical,* and one must define the relations of *constitution* and *realization.* The issue of what it is for particulars and properties to be physical is central and all too often overlooked, but I shall not here address it. I shall also have nothing to say concerning the constitution relation, as my focus will be on properties and not particulars. I shall, however, make a significant proposal concerning the realization relation, but for now a rough working definition of the *realization relation* will suffice: a property P of an object (or event) o realizes a property F of o if and only if (i) it is necessary that, if o instantiates P, then o instantiates F, and (ii) o's instantiating P in some metaphysical

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[2] Influential defenders of NRP and critics of disjunctive properties include: Hillary Putnam, "Psychological Predicates," in W.H. Capitan and D.D. Merrill, eds., *Art, Mind, and Religion* (Pittsburgh: University Press, 1967); Ned Block and Jerry Fodor, "What Psychological States Are Not," *Philosophical Review*, LXXXI, (1972): 159-81; and Fodor, "Special Sciences," in *Representations* (Cambridge: MIT, 1982), pp. 127-45.

[3] Two points. First, a weaker version of *physicalism* requires only that all property instantiations be instantiated in physical particulars. I think this weaker version of physicalism fails to capture the essence of NRP, but none of my arguments depends upon the stronger thesis. And second, the theoretical role played by the notion of *realization* in this characterization of physicalism is often played by the notion(s) of *supervenience.* It will become clear in section IV why I prefer to define physicalism in terms of realization.

sense explains o's instantiating F—being P is one *way in which* a thing can be F. So, for example, the property of being 85° C which is instantiated by my coffee cup is, it is plausible to suppose, realized by some very discriminating microphysical property which is also instantiated by my cup. Given that my cup has that discriminating microphysical property, it is necessary that it also have the property of being 85° C. And that my cup has that very discriminating microphysical property explains that my cup has the property of being 85° C—that particular microphysical property that my cup instantiates is one of many ways in which my cup could be 85° C. Thus to say that all mental properties are *realized* by physical properties is to say that for every instantiation of a mental property M by an object (or event) o, there is some physical property P instantiated by o such that it is necessary that, if o instantiates P, then o instantiates M, and o's being P explains—in the robust metaphysical sense—o's being M.[4]

As I have formulated the thesis of nonreducibility, it concerns the nonreducibility of mentalistic *predicates*, and not the nonreducibility of mental *properties*. In fact, strictly speaking the *reduction* relation holds between *theories*, but, at least within the framework of Ernest Nagel's[5] classic account of reduction, a derivative notion of reduction that holds between predicates can be specified. On Nagel's account, very roughly, a theory T_1 is reduced to a theory T_2 just in case the laws that make up T_1 are shown to be derivable from the laws that make up T_2, together with a set of "bridge principles" that "connect" the predicates of T_1 with predicates of T_2. We may take the existence and truth of such a bridge principle that connects predicates ϕ and ψ to be necessary and sufficient for the predicate reduction of ϕ by ψ.[6] Thus, the derivative notion of *predicate reduction* is defined as follows: predicate ϕ is reduced by predicate ψ if and only if there is a universally quantified bridge principle that connects ϕ and ψ. But

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[4] This sketch of the realization relation is essentially the account of realization proffered by Ernest LePore and Barry Loewer in "More on Making Mind Matter," *Philosophical Topics,* XVII, 1 (1989): 175-91.

[5] See *The Structure of Science* (New York: Harcourt, Brace and World, 1961). Nagel's account of theory reduction is sometimes criticized as requiring too much for theory reduction. Thus, even if the defender of NRP is able to show that mentalistic predicates are not Nagel-reducible to physicalistic predicates, she has not thereby adequately defended NRP, for a weaker, more accurate, account of theory reduction may allow for the reducibility of the mental to the physical. See, for example, John Bickle, "Multiple Realizability and Psychophysical Reduction," *Behavior and Philosophy,* XX, 1 (1992): 47-58. See also Patricia Churchland, *Neurophilosophy* (Cambridge: MIT, 1986).

[6] On this account, the relation of *predicate reduction* is symmetric. This is not problematic, as the relation of theory reduction is (still) asymmetric.

now, of course, we must clarify what it is for there to be a universally quantified bridge principle that "connects" ϕ and ψ. What relation must obtain between predicates ϕ and ψ if ϕ is to be connected to, and thereby reduced by, ψ?

The classic reductionists, or "type-type identity theorists," such as U.T. Place and J.J.C. Smart,[7] make it abundantly clear that a primary motivation for their theory is the ontological parsimony that results from identifying mental states with physical states. In the sense in which *reduction* is relevant to the mind-body problem and the tenability of NRP, the reduction of one theory T_1 to another theory T_2 collapses the ontological commitments of T_1 to those of T_2; if T_1 is reduced to T_2, then one who endorses both theories is committed to the existence of only the entities posited by T_2. Consequently, the bridge principles by which a reduction is obtained must be interpreted as entailing, or at least warranting the assertion of, property identities. (At least one must assent to this if one is to be a realist about properties and maintain that some predicates pick out, or designate, properties.) So in asking, "What relation must obtain between predicates ϕ and ψ if ϕ is to be reduced by ψ?" we are asking, "What relation must obtain between two predicates if they are to be taken to designate the same property?"

Fortunately, my purposes here do not require me to provide an answer to the contentious question of what conditions are necessary and jointly sufficient for predicate reduction. In order to clarify the argument from multiple realizability in support of NRP, and the "disjunctive strategy" in response to this argument, I need only the noncontentious assumption that a *necessary* condition for the predicate reduction of ϕ by ψ is that a universally quantified biconditional of the form $\ulcorner \forall x\, (\phi x \leftrightarrow \psi x) \urcorner$ be *nomologically necessary*. Whatever might be *sufficient* for predicates ϕ and ψ to designate the same property, it is at least *necessary* that such a universally quantified biconditional hold with nomological necessity.

The argument from multiple realizability is really an argument only in support of the thesis of nonreducibility; indeed, the argument is sometimes formulated in such a way that it presupposes the thesis of physicalism. The argument was first sketched by Putnam (*op. cit.*) and then clarified by Fodor (*op. cit.*) and it has been widely discussed since. Note that the argument from multiple realizability is alleged to demonstrate that the nonreducibility of mentalistic predicates by

[7] See Place, "Is Consciousness a Brain Process?" *British Journal of Psychology,* XLVII (1956): 44-50; and Smart, "Sensations and Brain Processes," *The Philosophical Review,* LXIIX (1959): 141-56.

physicalistic predicates follows from the fact that mental properties are multiply realized by physical properties. It is not obvious, however, how nonreducibility, which is at least in part an epistemological claim concerning *predicates*, could follow from the metaphysical claim that mental *properties* are multiply realized by physical properties. A mental property M is multiply realized by physical properties if and only if it has some *realization base* of physical properties P_1, P_2,...P_n ($n > 1$) where for each P_i in the realization base, P_i realizes M.[8] Suppose that mental property M is multiply realized by properties P_1, P_2,...P_n, and that a predicate μ designates M, and finally that for each P_i there is a corresponding predicate π_i designating P_i. Further suppose that P_1, P_2,...P_n are all *metaphysically incompatible* with each other; that is, for all objects o, o cannot instantiate both P_1 and P_2, nor both P_1 and P_3, and so on. It follows that M is not identical to any of the P_i.[9] Moreover, assuming that μ is predicate reduced by π_i only if a biconditional bridge principle of the form $\lceil \forall x\ (\mu x \leftrightarrow \pi_i x) \rceil$ is (at least) nomologically necessary, it follows that μ is not predicate reduced by any π_i: each P_i in M's realization base is sufficient, but not necessary, for M. Consequently, each π_i is such that satisfying π_i is sufficient, but not necessary, for satisfying μ, and thus no bridge principle with the form displayed above is nomologically necessary. So, μ cannot be predicate-reduced by any of the π_i. But how does it follow, as is required to support the thesis of nonreducibility, that mentalistic predicate μ cannot be reduced by any physicalistic predicate? It does not follow. In order to derive the thesis of nonreducibility an additional premise is needed, namely, that, if none of π_1, π_2,...π_n predicate reduces μ, then there is no *other* physicalistic pred-

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[8] In the terminology of Sydney Shoemaker, P_1, P_2, and so on are *total realizations* of M—"Some Varieties of Functionalism," *Philosophical Topics*, XII (1981): 83-118. Physicalism commits one to the existence of such total realizations. Shoemaker correctly distinguishes *total realizations* from what are usually taken to be realizations, which he calls *core realizations*. Core realizations are physical properties that *when combined with certain structural properties* realize a mental property. For example, according to philosophical lore, the physical property *undergoing C-fiber stimulation* when instantiated in a system with the structure of the human central nervous system realizes the mental property *pain*. But *undergoing C-fiber stimulation*, when it is instantiated in a *different* sort of physical structure, is not sufficient for pain. Thus, *core realizations* of mental properties are, strictly speaking, *not* realizations of mental properties.

[9] Suppose, for reductio, that M is identical to P_1. By hypothesis, if an object o instantiates P_2, then it instantiates M. But M is identical to P_1. So, contra the assumption of metaphysical incompatibility, o instantiates both P_1 and P_2. So M is not identical to P_1. Note that a more detailed statement of the argument would require a relativization to times, as an object o might instantiate P_1 at one time, yet not at another.

icate π^* that predicate reduces μ. If this additional, and rather strong, premise is granted, then the thesis of nonreducibility follows.

Here is where the reductionist can employ the "disjunctive strategy." The reductionist can claim that mentalistic predicate μ is reduced by the *exhaustive disjunctive predicate* $(\pi_1 \vee \pi_2 \vee ...\pi_n)$ where each π_i designates P_i, and all the P_i designated by some disjunct π_i *exhaust* the realization base of M. In other words, the reductionist can reject the rather strong additional premise, and maintain that there is some physicalistic predicate that designates M, namely, the disjunctive predicate $(\pi_1 \vee \pi_2 \vee ...\pi_n)$. The reductionist who employs the disjunctive strategy thus maintains that a disjunctive bridge principle of the form:

$(\vee\text{BP}) \ \forall x \ [\mu x \leftrightarrow (\pi_1 x \vee \pi_2 x \vee ...\pi_n x)]^{10}$

is sufficient for the predicate reduction of μx by $(\pi_1 x \vee \pi_2 x \vee ...\pi_n x)$.

II. FODOR, KIM, AND THE THREAT OF RAMPANT ILLEGITIMACY

I shall review here the debate between Fodor and Jaegwon Kim[11] concerning the disjunctive strategy. I shall argue that neither Fodor's nor Kim's position is acceptable. Fodor argues that, despite the necessary truth of bridge principles such as $(\vee\text{BP})$, the reductionist's disjunctive strategy fails. This because disjunctive predicates such as $(\pi_1 x \vee \pi_2 x \vee ...\pi_n x)$ fail to designate legitimate "scientific kinds," though mentalistic predicates such as μx do designate legitimate "scientific kinds."[12] Fodor concludes that psychology and the other

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[10] The modal strength of such disjunctive bridge principles depends upon the modal strength of the realization relation. For example, if 'P realizes F' entails 'If object or event o instantiates P, then it is *metaphysically necessary* that o instantiates F', then such disjunctive bridge principles hold with metaphysical necessity. Thus, such disjunctive bridge principles will hold with *at least* nomological necessity, as nomological necessity is, I assume, the weakest grade of modality in terms of which the realization relation could be plausibly defined.

[11] See Kim, "Multiple Realization and the Metaphysics of Reduction," in *Supervenience and Mind* (New York: Cambridge, 1993), pp. 309-35; and Fodor.

[12] A predicate might fail to designate a legitimate property, or in Fodor's terms, fail to determine a scientific kind, either because it fails to designate a property at all, or because it designates a property that is in some way illegitimate or unscientific. It is not clear to me what a real, yet illegitimate, property would be, and thus I do not see what the motivation for allowing for real, yet illegitimate, properties could be. It seems to me that the theoretical role played by a real, yet illegitimate, property would be better played by a *concept* that does not correspond to a real property. Kim seems to agree with me on this point, as he seems not to allow for real, yet illegitimate properties (*op. cit.*, pp. 334-35). But, unfortunately, Fodor (*op. cit.*) seems to allow for real yet illegitimate properties, properties that do not correspond with "kinds." At any rate, the distinction between existent yet illegitimate properties, and nonexistent properties is not central to my concerns, and thus I shall ignore it as much as is possible.

"special sciences" are autonomous in the sense that the laws of these special sciences cannot be reduced to the laws of physics. Kim responds by arguing that, given the necessary truth of $(\bigvee BP)$, Fodor cannot coherently accept μx as designating a legitimate kind *and* reject $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ on the grounds that it does *not* designate a legitimate kind; as Kim puts it: "It is difficult to see how one could have it both ways—that is, to castigate $[(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)]$ as unacceptably disjunctive while insisting on the integrity of $[\mu x]$ as [designating] a scientific kind" (*op. cit.*, p. 324). But Kim agrees with Fodor that $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ does not designate a legitimate kind, and thus Kim concludes that μx *also* fails to designate a legitimate kind. I shall argue that Kim is right to criticize Fodor; Fodor's reasons for claiming that $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ is unacceptable while μx is acceptable are confused, and thus Kim is right to insist that the two predicates stand or fall together. But I shall argue that the price of agreeing with Kim that the two predicates fall together is extremely high; it is the price of denying the legitimacy of all, or almost all, properties. Therefore, neither Fodor's nor Kim's position is acceptable.

Fodor objects to the disjunctive strategy on the grounds that disjunctive predicates such as $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ do not designate "scientific kinds." Suppose that there is a (perhaps nonstrict) law of psychology of the form

(PL) $\quad \Box \forall x \, (\mu_1 x \rightarrow \mu_2 x)$

where '$\Box$' designates a nomological necessity operator, and $\mu_1 x$ and $\mu_2 x$ are atomic mentalistic predicates. (Perhaps (PL) is a law in the "ideal" theory of psychology.) And now consider the disjunctive bridge principles which the reductionist utilizing the disjunctive strategy claims would serve to predicate reduce $\mu_1 x$ and $\mu_2 x$:

(BP1) $\quad \Box \forall x \, [\mu_1 x \leftrightarrow (\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)]$
(BP2) $\quad \Box \forall x \, [\mu_2 x \leftrightarrow (\pi'_1 x \bigvee \pi'_2 x \bigvee ... \pi'_n x)]$

Given (BP1) and (BP2), the following *physicalistic* law is equivalent to (PL):

(PL*) $\quad \Box \forall x \, [(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x) \rightarrow (\pi'_1 x \bigvee \pi'_2 x \bigvee ... \pi'_n x)]$

If (PL) is a law (and Fodor thinks that there are, or at least could be, such laws), then it would seem that (PL*) is also a law. (There is no problem substituting inside the nomological necessity operator '$\Box$', as (BP1) and (BP2) guarantee that $\mu_1 x$ and $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$, and $\mu_2 x$ and $(\pi'_1 x \bigvee \pi'_2 x \bigvee ... \pi'_n x)$, are *at least* nomologically coextensive.) But if (PL*) is a law, then the reductionist carries the day; for from

physicalistic law (PL*) together with bridge principles (BP1) and (BP2), psychological law (PL) can be derived, and in this way psychology could be reduced to a more basic physicalistic theory.

How does Fodor propose to preclude the purported (law) reduction of (PL) to (PL*)? Fodor claims that the predicates constituting the antecedent and consequent of a law must be "kind predicates." A "kind predicate" for Fodor is, apparently, a *previously formulated* predicate that appears in the previously formulated laws of some true theory. Thus, as Fodor would have it, $\mu_1 x$ and $\mu_2 x$ are "kind predicates" as, by assumption, they appear in previously formulated laws of a true psychological theory. And consequently (PL) is a law, as the predicates constituting its antecedent and consequent are "kind predicates." But, as $(\pi_1 x \vee \pi_2 x \vee ... \pi_n x)$ and $(\pi_1' x \vee \pi_2' x \vee ... \pi_n' x)$ are not previously formulated predicates that appear in a previously formulated law of some true theory, they are not "kind predicates" and, as a result, (PL*) is not a law. So psychology cannot be reduced to a physicalistic theory by deriving laws such as (PL) from disjunctive physicalistic "generalizations" such as (PL*).[13]

The upshot is that Fodor requires for the reduction of mentalistic predicate μx a previously formulated physicalistic predicate that is (at least) nomologically coextensive with μx. In other words, Fodor is more-or-less requiring for the reduction of psychology (biology, and the like) to physics that the theories of these special sciences turn out to be notational variants of part of the reducing physicalistic theory. The chances of this sort of correlation obtaining between theories in the special sciences and physics are, as Fodor suggests, slim. But this ought not console the defender of NRP, for Fodor's requirements for reduction are extremely strong, and go far beyond anything required

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[13] Fodor also objects to the "lawhood" of (PL*) on the grounds that "'it's a law that ____' defines a non truth functional context" (*op. cit.*, p. 140). Fodor argues as follows: "...one may not argue from: 'it's a law that P brings about R' and 'it's a law that Q brings about S' to 'it's a law that P or Q brings about R or S'... [F]or example,...it is a law that the irradiation of green plants by sunlight causes carbohydrate synthesis, and...it is a law that friction causes heat, but [it is not] a law that (either the irradiation of green plants by sunlight or friction) causes (either carbohydrate synthesis or heat)" (*ibid*, p. 140).

Fodor is correct that "'it's a law that ____' defines a non truth functional context," and thus the *general* inference Fodor describes is invalid. But this does not block the disjunctive strategy. In order to block the disjunctive strategy, Fodor must do more than show that the inference from 'it's a law that P brings about R' and 'it's a law that Q brings about S' to 'it's a law that P or Q brings about R or S' is *in general* invalid. To block the disjunctive strategy, he must show that this inference is invalid when P and Q exhaust the realization base of a property M_1, and R and S exhaust the realization base of M_2, and it is a proper law that M_1 brings about M_2. Fodor has given us no reason to be suspicious of the inference in this very special circumstance.

by Nagel's classic model of reduction, or any other model of reduc-
tion I know of.[14] Moreover, there are several independent reasons for
rejecting Fodor's requirement that for μx to be reduced, it must be
reduced by a previously formulated physicalistic predicate.

First, as was explained above, the issue of predicate reduction is—at
least in the context of the mind-body problem—really the issue of
property identity. If reduction is to have the ontological conse-
quences that the type-type identity theorist desires and the defender
of NRP fears, then reducing bridge principles must entail, or at least
warrant the assertion of, property identities. Thus, what matters for
predicate reduction is what the predicates designate, *not* that they
have been previously formulated. So Fodor cannot reject the disjunc-
tive predicate $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ merely on the grounds that it has
not previously been used to state scientific laws. The *familiarity* of the
predicate is irrelevant; what is relevant is what property, if any, the
predicate designates.

At this point, one might object that my interpretation of Fodor's
reason for rejecting $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ is uncharitable. For perhaps
Fodor rejects such disjunctive predicates not merely because they
have not previously been used to state scientific laws, but rather
because such predicates fail to designate legitimate properties or
"natural kinds." This objection has some merit; in some passages, it
seems that this is what Fodor has in mind.[15] The problem with this
interpretation of Fodor, however, is that it plays directly into the
hands of Kim's response:

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[14] Kim also criticizes Fodor on the grounds that he requires too much for
reduction (see *op. cit.*, footnote 21). In footnote 2 of "Special Sciences," Fodor
claims that he is working with what he takes to be the "classical form" of reduction,
though he also admits that it is "a stronger one than many philosophers of science
hold." He also claims that his argument against reductionism would hold against
even "liberalized versions" of reduction. I take myself to have demonstrated that
this latter claim is false.

[15] Fodor introduces the phrase 'kind predicate' with regard to "(natural) kinds"
(*op. cit.*, p. 132), thus suggesting that a predicate is an acceptable "kind predicate"
if and only if it designates, or "determines," a "natural kind," where the criteria for
being a natural kind are independent of any linguistic entity such as a science
and/or theory. Moreover, he seems to think that disjunctive predicates do not
designate "natural kinds"; at one point Fodor states, "I doubt that 'is either carbo-
hydrate synthesis or heat' is plausibly taken to be a kind predicate" (*op. cit.*, p. 140).
But Fodor later drops the phrase 'natural kind' and rejects the reductionist's appeal
to the disjunctive predicate $(\pi_1 x \bigvee \pi_2 x ... \pi_n x)$ on the grounds that it "is not a kind
predicate *in the reducing science*" (*op. cit.*, p. 138). In other words, Fodor seems to
begin with the plausible requirement for reduction that the predicates in a bridge
principle must designate "natural kinds," but then slides to the implausibly strong
requirement that the predicates in a bridge principle be previously formulated
predicates used to state the laws of the reducing science and/or theory.

If pain is nomically equivalent to N, the property claimed to be wildly disjunctive and obviously nonnomic, *why isn't pain itself equally heteroge-neous and nonnomic as a kind?* Why isn't pain's relationship to its real-ization bases, *Nb, Nr,* and *Nm,* analogous to jade's relationship to jadeite and nephrite? If jade turns out to be nonnomic on account of its dual "realizations" in distinct microstructures, why doesn't the same fate befall pain? After all, the group of actual and nomologically possible realizations of pain, as they are described by the MR enthusiasts with such imagination, is far more motley than the two chemical kinds comprising jade (*op. cit.,* p. 323).

Kim's criticism then, is this: if Fodor is interpreted as advancing the plausible requirement for reduction that the predicates in a bridge principle designate legitimate properties, or "natural kinds," then he cannot reasonably assert that mentalistic predicate μx designates a natural kind, while denying that the exhaustive disjunctive *predicate* $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ designates a natural kind. For, given the neces-sary truth of

$$(\lor BP) \; \forall x \, [\mu x \leftrightarrow (\pi_1 x \lor \pi_2 x \lor ... \pi_n x)]$$

if $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ fails to designate, or determine, a natural kind, then so does μx. Moreover, Kim argues that there is good reason to deny that heterogeneous disjunctive predicates such as $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ designated natural kinds. Kim does not object to such predicates merely because they are unfamiliar; rather, he objects to both μx and $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ for semantic and metaphysical reasons: "Given that mental kinds are realized by diverse physical causal kinds,...it follows that mental kinds are not causal kinds, and hence are disqualified as proper scientific kinds. Each mental kind is sundered into as many kinds as there are physical realization bases for it, and psychology as a science with disciplinary unity turns out to be an impossible project" (*op. cit.,* p. 327).

In the next section, I defend the legitimacy of "disjunctive proper-ties" from arguments such as Kim's. Here, I wish only to motivate my defense by highlighting an unsavory consequence of Kim's argument. It is clear that his argument against the legitimacy of mental proper-ties generalizes into an argument for the illegitimacy of all multiply realized properties; it is irrelevant to the argument that M is a *mental* property—all that matters is that M is multiply realized. For every multiply realized property designated by some predicate ρx there is, or there could be, a corresponding exhaustive disjunctive predicate $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ that is *at least* nomologically coextensive with ρx. So, if no disjunctive predicate of the form $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ determines a "scientific kind" or designates a legitimate property,

then no predicate such as px designates a legitimate property. But this is very problematic because all, or almost all, properties are multiply realized. If the fact that many different sorts of creatures can instantiate *being in pain* leads us to believe that *being in pain* is multiply realized, then the fact that many different sorts of things can instantiate, for example, *being green* ought to lead us to believe that *being green* is multiply realized. The point also holds for paradigmatic physical properties. Consider the paradigmatic physical property of having a mass of two grams. This property is instantiated by many different kinds of objects—bits of paper, bone, metal, jelly, and so on. Moreover, we expect that, if an object (or event) o instantiates a property P, then there is some noncausal explanation as to why o instantiates P; there must be something about o in virtue of which o instantiates P. That is, there must be some property R of o such that R realizes P. (So much is required by the "principle of sufficient reason," at least under one formulation of that principle.) For example, if a bit of plastic has a mass of two grams, then it instantiates that property in virtue of being composed of a certain number of certain sorts of molecules structured in a certain way. And if some very different sort of object o', say a bit of bone, also has a mass of two grams, then o' instantiates this property in virtue of being composed of a certain number of a certain other sorts of molecules structured in some other way. Claiming that a property P is *not* multiply realized is claiming that there are no properties in virtue of which objects instantiate P; it is tantamount to claiming that when an object instantiates P it is just a "brute fact" that it does so. But most philosophers are resistant to positing brute, unexplainable, facts, and to the extent that they are resistant to brute facts, they ought to be accepting of the claim that most if not all properties are multiply realized.[16]

[16] One might object to the theses that *most* properties are multiply realized on the grounds that *only* "higher-order" properties are multiply realized. This objection, however, fails to preclude rampant illegitimacy because, as the notion of a "higher-order property" is usually defined, almost all properties are higher-order properties. Louise Antony and Joseph Levine define a *higher-order property* as "a property you have in virtue of having some other property that meets certain specifications"—see "Reduction with Autonomy," *Philosophical Perspectives*, XI (1997): 83-105, here p. 85. The problem is that almost every property is associated with some sort of causal/functional role, and thus meets this criterion. Similarly, one can apply the Ramsey/Lewis method to define almost any predicate. For similar accounts of functional/higher-order properties, see Kim "The Mind-Body Problem: Taking Stock After Forty Years," *Philosophical Perspectives*, XI (1997): 185-205; Block "Can the Mind Change the World?" in George Boolos, ed., *Meaning and Method: Essays in Honor of Hilary Putnam* (New York: Cambridge, 1990), pp. 137-70; and Putnam.

If the above considerations are correct and thus most, if not all, properties are multiply realized, then the advocate of NRP has a serious problem. For if, following Fodor, she rejects the reductionist's appeal to exhaustive disjunctive predicates on the grounds that such predicates do not designate legitimate properties, then she is evidently required to deny the legitimacy of all multiply realized properties. The price of rejecting the reductionist's appeal to "disjunctive properties" is rampant illegitimacy. The entire argument is explicitly formulated as follows:

(1) For each multiply realized property R designated by predicate ρx, there is an exhaustive disjunctive predicate $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ such that each $\pi_i x$ designates P_i where P_i realizes R, and $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ contains one disjunct for each property that realizes R.[17]
(2) ρx is *at least* nomologically coextensive with $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$.

But since

(3) If ρx and $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ are (at least) nomologically coextensive, then ρx designates a legitimate property only if $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ designates a legitimate property.

it follows that:

(4) ρx designates a legitimate property only if $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ designates a legitimate property.

But in order to undermine the disjunctive strategy and thereby avoid reductionism, the defender of NRP has claimed, following Putnam and Fodor, that:

(5) Such heterogeneous disjunctive predicates as $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ do not designate legitimate properties.

Therefore:

(6) ρx does not designate a legitimate property.

But

(7) All, or almost all, properties are multiply realized.

And consequently:

(8) Few, if any, of our predicates designate legitimate properties.

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[17] This premise presupposes that all the properties in R's realization base can be designated by predicates. This assumption probably must be rejected by anyone who is a realist about properties, and this suggests an alternative response to the argument. Related issues will be discussed in section IV.

The conclusion, (8), is unacceptable, and the argument is valid. Moreover, I have argued that the only dubious premise is (5). Thus there is cogent reason for hoping that at least some exhaustive disjunctive predicates such as $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ do designate legitimate properties (or at least they would if they were formulated); the price of denying this is that of accepting the unsavory conclusion that all, or almost all, properties are illegitimate. If rampant illegitimacy is to be avoided, an acceptable account of disjunctive properties must be formulated.

III. DEVELOPMENT OF A CAUSAL POWER ACCOUNT OF DISJUNCTIVE PROPERTIES

Before an acceptable account of disjunctive properties can be formulated, it must be made clear what it would be for a property to be a *disjunctive* property. I have been, and shall continue to be, assuming a naive realism concerning properties; properties are mind-independent entities, at least some of which are designated by predicates. A disjunctive property, one quickly thinks, is what one gets when one takes property P and property Q and then forms their disjunction. But this account involves a use/mention confusion: one can form the disjunction of predicate ϕ and predicate ψ, namely, $\ulcorner \phi \lor \psi \urcorner$, but one cannot literally form a disjunction of properties any more than one could form a disjunction of, say, particular people.[18] Let us define the notion of a *properly disjunctive predicate*: a disjunctive predicate $(\pi_1 \lor \pi_2 \lor ... \pi_n)$ is a properly disjunctive predicate if and only if (i) there is more than one disjunct π_i; (ii) each disjunct π_i designates a legitimate property; and (iii) each π_i designates a distinct property. The notion of a *disjunctive property* is now defined as follows: P is a disjunctive property if and only if P can be designated by a properly disjunctive predicate. (In terms of the lambda calculus, P is a disjunc-

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[18] In a puzzling passage in "Concepts of Supervenience," in *Supervenience and Mind,* Kim eschews infinite disjunctive predicates, yet endorses the "operation" of disjunction applied to infinitely many properties: "...such operations as infinite conjunctions and infinite disjunctions would be highly questionable for predicates, but not necessarily for properties—any more than infinite unions and intersections are for classes. The property of being less than one meter long can be thought of as an infinite disjunction (e.g. of all properties of the form being less than n/n+1 meters long, for every natural number n)" (p. 73).

I share Kim's uneasiness concerning infinite predicates. But, while it is relatively clear what a disjunction of predicates is, it is not at all clear what a disjunction of properties is.

tive property if and only if for some predicates ϕ and φ...designating *distinct* legitimate properties, P is designated by $\ulcorner\lambda x(\phi x$ or φx or...$)\urcorner$.[19]

Thus the nonreductionist's claim that there are no disjunctive properties (premise (5) in the above argument) is interpreted to mean that properly disjunctive predicates do not designate legitimate properties; such predicates are either "empty" or designate illegitimate, "unscientific," properties. Note that the exhaustive disjunctive predicates by which the reductionist proposes reducing mentalistic predicates are properly disjunctive predicates; they satisfy conditions (i)-(iii) above. Consequently, since all or almost all properties are multiply realized, the nonreductionist's claim that there are no legitimate disjunctive properties entails rampant illegitimacy.

My strategy for formulating an acceptable account of disjunctive properties will be to explicate and criticize two of David Armstrong's[20] influential arguments against the legitimacy of disjunctive properties. These negative arguments serve as constraints on an acceptable account of disjunctive properties in the sense that—at the cost of rampant illegitimacy—an acceptable account of disjunctive properties must allow at least some disjunctive properties to survive these negative arguments. Thus, in responding to these arguments, I

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[19] One could also provide a nonmetalinguistic account of *disjunctive properties* as follows: let properties be functions from possible worlds to sets of entities in those worlds; that is, property P is a function $f(\ )$ such that for worlds w, $f(w) = \{x: x$ has P in $w\}$. The disjunction $f_d(w)$ of properties $f_1(\ )$ and $f_2(\ )$ is defined as follows: for all w, $f_d(w) = f_1(w) \cup f_2(w)$. A property could then be defined as a *disjunctive property* as follows: property P is *disjunctive* if and only if there are properties Q and R such that P is the disjunction of Q and R. To avoid the result that all properties are disjunctive, various restrictions could be placed on Q and R; for example, it might be required that Q and R be "natural" or "basic" properties.

The problem with this account of disjunctive properties, aside from that of specifying the "natural" properties, is that it is not clear how to relate it to the debate surrounding the argument from multiple realizability. Note that prima facie there is no reason to suppose that disjunctive predicates such as $(\pi_1 x \lor \pi_2 x \lor ...\pi_n x)$ designate disjunctive properties in this sense. Nor is there reason to suppose that atomic predicates do not designate such disjunctive properties.

[20] *A Theory of Universals: Universals and Scientific Realism, Volume II* (New York: Cambridge, 1978). For other arguments against disjunctive properties, see D.H. Mellor, "Predicates and Properties," in Mellor and Alex Oliver, eds., *Properties* (New York: Cambridge, 1997); David Owens, "Disjunctive Laws," *Analysis*, IL (1989): 197-202; and Kim, "Multiple Realization and the Metaphysics of Reduction," in *Supervenience and Mind*, pp. 309-35. Mellor's argument is successfully criticized by Andrew Botterell in "Mellor on Negative Properties," *The Philosophical Quarterly*, XLVIII, 193 (1998): 523-26. Owens and Kim's argument is successfully criticized by Fodor in "Special Sciences: Still Autonomous After All These Years," in *In Critical Condition: Polemical Essays on Cognitive Science and the Philosophy of Mind* (Cambridge: MIT, 1998), pp. 11-12.

shall be taking significant steps toward the development of an accept-able account of disjunctive properties.

Armstrong's first argument against disjunctive properties is this:

> disjunctive properties offend against the principle that a genuine prop-erty is identical in its different particulars. Suppose a has a property P, but lacks Q while b has Q but lacks P. It seems laughable to conclude that from these premises that a and b are identical in some respect. Yet both have the "property", P *or* Q (*op. cit.*, p. 20).

This argument seems persuasive when applied to the sort of ex-tremely "heterogeneous" disjunctive predicate Armstrong had in mind. Consider his favorite example: 'is a raven or a writing desk'. It would be at least odd to say that the entities in the extension of 'is a raven or a writing desk' all resemble each other, or "are identical in some respect."[21] Thus the argument shows that not *all* properly disjunctive predicates designate properties. But it by no means fol-lows that *no* properly disjunctive predicates designate properties. Consider, for example, the (perhaps infinite) disjunctive predicate $(\chi_1 x \vee \chi_2 x \vee ...\chi_n x)$ where each disjunct $\chi_i x$ designates a distinct color property, C_i, and *every* color is designated by some χ_i. (Thus $(\chi_1 x \vee \chi_2 x \vee ...\chi_n x)$ is something like, 'is either red or blue or green or yellow or orange...'.) This predicate satisfies requirements (i)-(iii) for being a *properly disjunctive predicate*. Thus, if it designates a property, then, by the above definition of disjunctive property, it designates a disjunctive property. The property *being blue* (or being a very particular shade of blue) is one of the C_i, and *being blue* is a *determinate* of the *determinable* property *being colored—being blue* is one of the ways in which a thing can be colored, and if a thing is blue, then it *must* be colored. To put the point in more relevant terminology, *being blue realizes being colored*; more generally, *determinables* with more than one *determinate* are one sort of *multiply realized* property.[22] Consequently, because the prop-erly disjunctive predicate $(\chi_1 x \vee \chi_2 x \vee ...\chi_n x)$ is *exhaustive*, it is nec-essarily true that it is satisfied by all and only colored objects. Therefore, assuming that the entities that instantiate *being colored* all

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[21] It would not, however, be false to say this. For example, all ravens and all writing desks have mass, and thus are identical in this respect. But it suits my explanatory purposes to grant this point to Armstrong, at least with regard to his first argument.

[22] The isomorphism between realized and realizing properties, on the one hand, and determinables and determinates, on the other, was, I believe, first noticed by Stephen Yablo, who utilizes the isomorphism to explain the causal relevance of mental events—"Mental Causation," *The Philosophical Review*, CI (1992): 245-80. My views concerning disjunctive properties are significantly influenced by Yablo's insights.

resemble each other in some respect, there is a *respect* in which all objects in the extension of $(\chi_1 x \bigvee \chi_2 x \bigvee ... \chi_n x)$ resemble each other, namely, *being colored.*

The same response, mutatis mutandis, illustrates that the exhaustive properly disjunctive predicate $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$, by which the reductionist proposes reducing mentalistic predicate μx, also serves as a counterexample to Armstrong's first argument. For μx and $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ are also necessarily coextensive. Consequently, there is a "respect," namely, M, in which all the entities in the extension of $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ resemble each another. As is required to steer clear of rampant illegitimacy, this most relevant case serves as a counterexample to Armstrong's first argument against disjunctive properties, and thus his argument does not demonstrate that all properly disjunctive predicates fail to designate legitimate properties.

Although Armstrong's first argument fails to support the nonreductionist's rejection of disjunctive properties, it does serve to highlight a significant constraint on disjunctive properties. His first argument fails to demonstrate that $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ designates a legitimate property because the $\pi_i x$ which are disjoined to form $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ *overlap* on a property. Consider again all specific color predicates and the determinable *being colored.* All specific color predicates can be said to overlap on the property *being colored* because an object that satisfies any one of the specific color predicate must instantiate *being colored.* Generalizing now, the disjuncts of a disjunctive predicate can be said to *overlap* if and only if there is some property R such that every possible object (or event) that satisfies *any* of the disjuncts *must* instantiate R. It is because its disjuncts overlap on M that $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ survives Armstrong's first argument: because the disjuncts overlap on M, there is a "respect" in which all the objects (or events) in the extension of $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$ resemble each other, namely, M. Although Armstrong's first argument does not succeed in demonstrating that there are no disjunctive properties, it does succeed in demonstrating that a necessary condition for a properly disjunctive predicate's designating a legitimate property is that the disjuncts of the predicate overlap on a property.

Armstrong's second argument against disjunctive properties is this:

> the postulation of disjunctive properties breaks the link which it is natural to make between properties of things and causal powers of things. Suppose...that a has P but lacks Q. The predicate 'P$\bigvee$Q' applies to a. Nevertheless, when a acts, it will surely act only in virtue of its being

P. Its *being P or Q* will add no power to its arm. This suggests that *being P or Q* is not a property (*op. cit.*, p. 20).[23]

This argument presupposes a causal power conception of properties, the essentials of which Armstrong describes in this passage:

(a) The active and passive powers of particulars are determined by their properties. (b) Every property bestows some active and/or passive power[s] upon the particulars of which it is a property. (c) A property bestows the very same causal power[s] upon any particular of which it is a property. (d) Each different property bestows a different [set of] power[s] on the particulars of which it is a property (*op. cit.*, pp. 43-44).

(I have amended Armstrong's conception slightly to allow properties to bestow nonempty sets of causal powers rather than just single causal powers. It is not clear whether or not Armstrong would accept this amendment.[24])

Armstrong does not extend this conception of properties as bestowing causal powers to an account of the conditions under which a predicate designating a legitimate property is satisfied by an object, but it is relatively clear how the conception ought to be so extended. Legitimate properties bestow causal powers on the objects that instantiate them; an object o instantiates a legitimate property P if and only if o possesses every causal power bestowed by P. It will simplify matters if, instead of speaking of properties "bestowing" causal powers, properties are simply identified with sets of causal powers. Thus, I shall sometimes speak of a property being *constituted by* a set of causal powers. The causal power model of properties together with this simplifying assumption implies the following necessary and jointly sufficient conditions for a predicate's designating a property:

Predicate π designates a property P *if and only if* there is some nonempty set of causal powers p such that (a) if a particular o satisfies π then o possesses every power in p, and the converse (b) if a particular o possesses every power in p, then o satisfies π.

Armstrong's second argument again is cogent when applied to extremely heterogeneous properly disjunctive predicates such as his example, 'is a raven or a writing desk'. The problem is that this

[23] This is actually Armstrong's third argument against disjunctive properties, but his second argument is neither successful nor relevant to my purposes.

[24] These amendments bring Armstrong's causal power model of properties more in line with the model proposed by Shoemaker; see "Causality and Properties," in Peter van Inwagen, ed., *Time and Cause* (Boston: Reidel, 1980), pp. 229-54, and "Causal and Metaphysical Necessity," *Pacific Philosophical Quarterly*, LXXIX (1998): 59-77. My views on these matters owe much Shoemaker's work.

predicate does not meet conditions (a) and (b). That is, there is no set of causal powers d such that (a) every particular that satisfies 'is a raven or a writing desk' possesses every causal power in d, and (b) every particular that possesses every causal power in d satisfies 'is a raven or a writing desk'. Let r be the set of causal powers associated with the predicate 'is a raven', and w be the set of causal powers associated with 'is a writing desk'. Set of causal powers d cannot be identified with r, because writing desks satisfy 'is a raven or a writing desk' yet do not possess all the causal powers in r. Thus condition (a) is violated. Nor can d be identified with w, for ravens satisfy 'is a raven or a writing desk' yet do not possess all the causal powers in w. Thus condition (a) is again violated. And a fortiori d cannot be identified with $r \cup w$, because many ravens satisfy 'is either a raven or a writing desk' but do not possess all the powers in $r \cup w$, and many writing desks also satisfy 'is a raven or a writing desk' but do not possess all the powers in $r \cup w$. Clearly, then, in order to satisfy condition (a), d must be a subset of *both* r and w. Perhaps then d can be identified with $r \cap w$. Note that it is unlikely that $r \cap w$ is the empty set. For there are *some* causal powers shared by all possible ravens and writing desks. For example, surely every possible raven or writing desk has mass, and *having mass* is a property, and thus everything that instantiates this property must possess every member of a nonempty set of causal powers. So $r \cap w$ is not the empty set. But nonetheless d cannot be identified with $r \cap w$. The problem is that it is likely that there are many possible things that possess all the causal powers in $r \cap w$, but do not satisfy the predicate 'is either a raven or a writing desk'. If an object o possesses all the causal powers that all ravens and writing desks have in common, it does not follow that o is either a raven or o is a writing desk. There are, for example, many things that possess all the causal powers bestowed by the property *having mass* that are neither ravens nor writing desks. And thus d cannot be identified with $r \cap w$ on pain of condition (b) being violated. Moreover, and a fortiori, d cannot be identified with any proper subset of $r \cap w$. If there are objects that possess every causal power in $r \cap w$ yet do not satisfy 'is either a raven or a writing desk', then for any proper subset of $r \cap w$ there will be objects that possess every causal power in it, but do not satisfy 'is either a raven or writing desk'.

So Armstrong's second argument, like his first argument, succeeds in demonstrating that 'is either a raven or a writing desk' fails to designate a legitimate property. But his second argument, again like his first argument, does not demonstrate that *no* properly disjunctive predicate designates a property. Consider again the exhaustive disjunction of color predicates, $(\chi_1 x \vee \chi_2 x \vee ... \chi_n x)$, where each disjunct

$\chi_i x$ designates a distinct color property, C_i, and each such property C_i is constituted by a set of causal powers c_i. If $(\chi_1 x \vee \chi_2 x \vee ... \chi_n x)$ designates a legitimate property, there must be some nonempty set of causal powers d' such that (a) every possible thing that satisfies $(\chi_1 x \vee \chi_2 x \vee ... \chi_n x)$ possesses every causal power in d', *and* (b) every possible thing that possesses every causal power in d' satisfies $(\chi_1 x \vee \chi_2 x \vee ... \chi_n x)$. Is there a set of causal powers that meets conditions (a) and (b)? In this case, there is good reason to suppose that there is. Specifically, there is good reason to suppose that the intersection of the all the sets of causal powers constituting the properties designated by the disjuncts, namely, $c_1 \cap c_2 ... \cap c_n$, meets both conditions.

First, assuming the causal power model of properties, it is incontestable that $c_1 \cap c_2 ... \cap c_n$ meets condition (a). Suppose an object o satisfies $(\chi_1 x \vee \chi_2 x \vee ... \chi_n x)$. Then o must satisfy one of the disjuncts $\chi_i x$. But if o satisfies one of the disjuncts $\chi_i x$, then it must instantiate the property C_i designated by that disjunct, and thus it must possess every causal power in the set of causal powers c_i that constitute C_i. But if o has every causal power in some set c_i, then o necessarily has every causal power in $c_1 \cap c_2 ... \cap c_n$. So $c_1 \cap c_2 ... \cap c_n$ meets condition (a).

It is not incontestable that $c_1 \cap c_2 ... \cap c_n$ meets condition (b) because the argument that it does so presupposes a particular account of the *realization* relation. This account of realization, however, is strongly suggested by the causal power model of properties. According to the working definition of *realization*, a property P *realizes* a property Q if and only if (i) if an object (or event) o instantiates P, then, necessarily, o instantiates Q, and (ii) o's being P explains—in a metaphysical sense—o's being Q; being P is one of the *ways in which* a thing can be Q. On the causal power model of properties, an object instantiates a property if and only if it possesses every causal power in the set that constitutes that property. So, putting these ideas together leads naturally to the following general definition of *realization*:

> P *realizes* Q if and only if (def.), where p and q are the sets of powers constituting P and Q, $q \subset p$.

Consider the relation that obtains between the determinate property *being yellow* and the determinable of that determinate, *being colored*. Because property P's being a determinate of a determinable property Q is sufficient for P's *realizing* Q, *being yellow* realizes *being colored*. On the causal power model of properties, the properties *being yellow* and *being colored* are constituted by sets of causal powers. Let us call these sets of causal powers y and c, respectively. Now consider all the things that instantiate *being yellow*. These things are yellow in virtue of having *all* the causal powers in set y. And consider all the

things that instantiate *being colored*. These things are colored in virtue of possessing *all* the causal powers in set *c*. What relation obtains between *c* and y? Clearly, *c* is a proper subset of *y*: every causal power something possesses in virtue of instantiating *being colored* is also a power it possesses in virtue of instantiating *being yellow*. But not every power a thing possesses in virtue of instantiating *being yellow* is a power it possesses in virtue of instantiating *being colored*. (For example, yellow warning signs are visible to drivers at night, but blue, green, and purple signs are not.) And consider the relation that obtains between the set of causal powers constituting the mental property M and one of M's realizors, P_1. Let us identify these properties with sets of causal powers m and p_1. Again, consider all the things that instantiate M. These things are M in virtue of possessing all the causal powers in m. And consider all the things that instantiate some realizing property P_1. These things instantiate P_1 in virtue of possessing all the causal powers in p_1. What relation obtains between m and p_1? Again, it is clear that m is a proper subset of p_1: every power something possesses in virtue of instantiating M is also a power something would posses in virtue of instantiating P_1. But not every power a thing possesses in virtue of instantiating P_1 is a power it would possess in virtue of instantiating M. (For example, suppose M is *believing that snow is white*. And suppose, as functionalism would have us believe, that this mental property can be instantiated by a machine made of steel, and that only such steel machines instantiate P_1. Such a machine would possess the power of being magnetic in virtue of instantiating P_1, but it would not posses the power of being magnetic in virtue of instantiating *believing that snow is white*.)

  If one grants the above account of realization, then $c_1 \cap c_2 ... \cap c_n$ meets condition (b); that is, if an object o possesses every causal power in $c_1 \cap c_2 ... \cap c_n$, then o satisfies $(\chi_1 x \lor \chi_2 x \lor ... \chi_n x)$. According to the above account of realization, a multiply realized property is constituted by the intersection of the sets constituting its realizors.[25]

[25] Let C be the set of causal powers constituting *being colored*, and let c_1 and c_2 and ...c_n be sets of causal powers constituting specific color properties. Suppose C has as a member some causal power cp that is not a member of $c_1 \cap c_2 ... \cap c_n$. Then there would have to be a c_i that did not have cp as a member. But then something could possess all the causal powers in this c_i yet not possess all the powers in C. So, a thing could instantiate the color property constituted by this c_i yet not instantiate *being colored*. But this is absurd, as every thing that is some specific color or other is colored. So C cannot contain some causal power that is not a member of $c_1 \cap c_2 ... \cap c_n$. Conversely, suppose $c_1 \cap c_2 ... \cap c_n$ has as a member some causal power that is not a member of C. Then a thing could have every causal power constituting *being colored*, yet lack a causal power that is possessed by every object that instantiates some specific color property or other. So, an object could instantiate being colored,

Thus $c_1 \cap c_2 ... \cap c_n$ constitutes *being colored*. Therefore, any object o that possesses all of the causal powers in $c_1 \cap c_2 ... \cap c_n$ instantiates *being colored*. But if o instantiates *being colored*, then o must instantiate some specific color property P_i. That is, if o has all of the causal powers in $c_1 \cap c_2 ... \cap c_n$, then o must either have all the causal powers in c_1, or have all the causal powers in c_2, or.... But if o possesses all the causal powers in some set c_i, then o must satisfy the corresponding disjunct $\chi_i x$, and hence o must satisfy $(\chi_1 x \lor \chi_2 x \lor ... \chi_n x)$. So, assuming the account of realization that is strongly suggested by the causal power model of properties, $c_1 \cap c_2 ... \cap c_n$ also meets condition (b).

The same arguments apply, mutatis mutandis, to the most relevant case of the reductionist's properly disjunctive predicate, $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$. For each realizing physical property P_i designated by a disjunct $\pi_i x$, let p_i be the set of causal powers that constitutes P_i. For the reasons given above, the set $p_1 \cap p_2 ... \cap p_n$ meets both conditions: Condition (a) is met because every possible thing that satisfies $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ possesses every causal power in $p_1 \cap p_2 ... \cap p_n$, and condition (b) is met because every possible thing that possesses every causal power in $p_1 \cap p_2 ... \cap p_n$ satisfies $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$. And consequently, as is required to avoid rampant illegitimacy, it cannot be concluded from Armstrong's second argument that the reductionist's $(\pi_1 x \lor \pi_2 x \lor ... \pi_n x)$ fails to designate a legitimate property.

Armstrong's second argument, like his first argument, fails to demonstrate that no properly disjunctive predicates designate legitimate properties. But the argument serves to place an additional constraint on an acceptable account of disjunctive properties. A predicate π designates a legitimate property P if and only if there is some nonempty set of causal powers p such that (a) if a particular o satisfies π, then o possesses every power in p, and the converse, (b) if a particular o possesses every power in p, then o satisfies π. What must be true of a properly disjunctive predicate if it is meet conditions (a) and (b)? The constraint derived from Armstrong's first argument is that the disjuncts of a properly disjunctive predicate must *overlap* on a property. Let us now redefine the notion disjuncts overlapping in terms of the causal power model of properties: the disjuncts of a disjunctive predicate *overlap* on set of powers if and only if every object (or event) that satisfies any of the disjuncts must possess every

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yet not instantiate some specific color property. But this also is absurd: every thing that is colored is some specific color. Therefore, the set of causal powers constituting *being colored* must be the intersection of all the sets of causal powers constituting specific color properties. And, generalizing now, a multiply realized property is constituted by the intersection of the sets constituting its realizors.

causal power in that set. It can now be discerned that it is necessary and sufficient for a properly disjunctive predicate's meeting condition (a) that its disjuncts overlap on a set of causal powers. What Armstrong's second argument illustrates is that condition (b) must also be satisfied. That is, it is not enough for $(\pi_1 x \vee \pi_2 x \vee ... \pi_n x)$ to designate a legitimate property that its disjuncts overlap on property M; it also must be the case that any object that instantiates M must satisfy $(\pi_1 x \vee \pi_2 x \vee ... \pi_n x)$. Let us say that a properly disjunctive predicate that has both of these features is such that its disjuncts *satisfactorily overlap.*

I conclude that Armstrong's arguments demonstrate that properly disjunctive predicates whose disjuncts do not satisfactorily overlap fail to designate legitimate properties. Assuming the causal power model of properties and the attendant account of realization, however, a properly disjunctive predicate whose disjuncts satisfactorily overlap does designate a legitimate property. These results entail the following general account of disjunctive properties: a properly disjunctive predicate designates a legitimate property if and only if its disjuncts *satisfactorily overlap.* Moreover, in the most relevant case of the reductionist's exhaustive properly disjunctive $(\pi_1 x \vee \pi_2 x \vee ... \pi_n x)$ where each disjunct $\pi_i x$ designates one of M's realizors, the disjuncts satisfactorily overlap on the intersection of the sets of causal powers constituting M's realizors, namely, $p_1 \cap p_2 ... \cap p_n$. These results are desirable, as they provide a means for avoiding rampant illegitimacy. More specifically, because the disjuncts of the reductionist's exhaustive properly disjunctive predicates satisfactorily overlap, premise (5) in the argument presented in section II can be rejected.

IV. THE CONSEQUENCES FOR NRP

The causal power model of properties and the attendant accounts of disjunctive properties and the realization relation have significant consequences for NRP. Recall that NRP is the conjunction of two theses:

Physicalism: all particulars are constituted by physical particulars, and all properties are realized by physical properties.
Nonreducibility: mental predicates *cannot* be reduced by physical predicates.

The above definition of realization serves to clarify and support the thesis of physicalism. First, the definition immediately secures the result, central to NRP, that mental properties are not identical to the physical properties that realize them, for no set is identical to one of its proper subsets. Second, the definition helps to clarify that NRP is incompatible with the metaphorical claim, often associated with NRP,

that mental properties exist "over and above" their realizors. According to the above well-motivated definition, multiply realized mental properties, though real and causally efficacious, are better thought of as *parts* of their physical realizors. The definition thus undermines the standard "levels" picture, according to which mental properties exist "at a higher level" than their physical realizors, and consequently it falsifies Kim's equation of NRP with some form of emergentism.[26] The falsification of this equation is an extremely beneficial result for NRP, for without this equation the problems forcefully presented by Kim concerning causal and explanatory exclusion of mental properties by physical properties do not arise.[27] Just as there is no causal and/or explanatory competition between a whole and its parts, so there is no causal and/or explanatory competition between instances of mental properties and instances of their physical realizors. And, finally, the causal power model of properties combined with the above definition of the realization relation surpass the old notions of supervenience in providing an explanation of the relation between mental properties and physical properties. Kim[28] has recently complained that "mind-body supervenience is not an explanatory theory; it merely states a pattern of property covariation between the mental and the physical, and points to the existence of a dependency relation between the two. Yet it is wholly silent on the nature of the dependency relation that might explain why the mental supervenes on the physical" (*ibid.*, p. 190). The above definition of realization provides at least the foundation for an explanation of this dependency relation: mental properties depend upon physical properties because mental properties in part constitute certain physical properties. Of course, all of these remarks are highly programatic, and carrying out the relevant programs would require a more detailed working out of the causal power model of properties than I have attempted here. But these remarks do illustrate that advocates of NRP have much to gain from adopting the causal power model of properties and the definition of realization that is implied by that model.

Although the causal power model of properties and the attendant account of realization provide some support for and clarification of

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[26] See Kim, "The Nonreductivist Troubles with Mental Causation," in John Heil and Alfred Mele, eds., *Mental Causation* (New York: Oxford, 1993), pp. 189-210.

[27] See Kim (*op. cit.*), and "The Myth of Nonreductive Materialism," *Proceedings and Addresses of the American Philosophical Association*, LXIII (1989): 31-47.

[28] "The Mind-Body Problem: Taking Stock After Forty Years," *Philosophical Perspectives*, XI (1997): 185-205.

the thesis of physicalism, they seem to spell trouble for the thesis of nonreducibility. The most prevalent argument in support of nonreducibility is the argument from multiple realizability, which argues that mentalistic predicates such as μ cannot be reduced by any physicalistic predicate because mental properties are multiply realized by physical properties. Against this argument the reductionist can employ the "disjunctive strategy": he can argue that, despite the phenomenon of multiple realization, mentalistic predicates such as μ are reduced to physicalistic predicates by way of disjunctive bridge principles of the form:

$$(\bigvee BP) \ \forall x \ [\mu x \leftrightarrow (\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)]$$

The standard nonreductionist reply to the reductionist's "disjunctive strategy" is to "question the propriety of $[(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)]$ as a legitimate property."[29] But the considerations of the previous sections undermine this standard nonreductionist reply, for they provide the reductionist with a well-motivated and plausible account of "disjunctive properties," and on this account the reductionist's exhaustive disjunctive predicates would designate legitimate properties. Thus, unless another reply to the disjunctive strategy can be formulated, rampant illegitimacy is avoided only at the cost of the argument from multiple realizability in support of nonreducibility.

Fortunately, another reply to the disjunctive strategy can be formulated, and the formulation of this reply serves to clarify NRP further. Consider again the bridge principle schema $(\bigvee BP)$, and in particular the disjunctive predicate schema $(\pi_1 x \bigvee \pi_2 x \bigvee ... \pi_n x)$. What exactly is this disjunctive predicate schema schematic of? As is often pointed out, it is likely that mental property M, whatever it is, will have an infinite realization base. This will mean that to predicate reduce μ the reductionist must invoke an exhaustive disjunctive predicate that has infinitely many disjuncts. But nobody ever has, or ever will, formulate an infinite predicate. Moreover, nobody has ever even formulated a single predicate $\pi_1 x$ such that for some mental property M, the property designated by $\pi_1 x$ realizes M. (One reason for this is that the physical realizors of many mental properties are *wide*—they include complex environmental features external to the creature instantiating the mental state.) In short, the reductionist's appeal to exhaustive disjunctive predicates is an idealization of a rather extreme sort. We are familiar with many mentalistic predicates that, it is assumed here, designate mental properties. But we have no idea

[29] Kim, *The Philosophy of Mind,* (New York: Westview, 1996), p. 219.

what the relevant disjunctive predicates might be, and we have good reason to believe that we cannot really formulate such disjunctive predicates. The reductionist's appeal to disjunctive predicates must then be understood as a claim concerning what is *in principle possible*; it is a claim to the effect that some sort of epistemologically ideal being could reduce mentalistic predicates by exhaustive infinite disjunctions of physicalistic predicates. The reductionist is asserting the counterfactual claim that *if we could* formulate infinite physicalistic predicates of the form $(\pi_1 x \vee \pi_2 x \vee ... \pi_n x)$, then we could reduce mentalistic predicates. Moreover, the results of the previous sections suggest that the reductionist's counterfactual claim is, despite the arguments against disjunctive properties, true. But is the truth of the reductionist's counterfactual claim incompatible with the thesis of nonreducibility?

It all depends on how the thesis of nonreducibility is interpreted. If the 'cannot' in this thesis is interpreted to be very strong, so that the thesis states that it is not even in principle possible to reduce mentalistic predicates, then the reductionist carries the day. For his counterfactual claim is true: *if* we *could* formulate exhaustive infinite physicalistic predicates of the form $(\pi_1 x \vee \pi_2 x \vee ... \pi_n x)$, then we could reduce mentalistic predicates. But if the 'cannot' is interpreted to be less strong, so that the reductionist's counterfactual claim is compatible with nonreducibility, then the defender of NRP carries the day. And this is the appropriate response for the defender of NRP to make against the disjunctive strategy: the defender of NRP should grant that it is in principle possible for mentalistic predicates to be reduced by exhaustive disjunctive predicates, but he should deny that this is incompatible with nonreducibility. This weaker version of NRP does not deny that it is in principle possible for "ideal" scientists to formulate physicalistic predicates that would reduce our mentalistic predicates. (It is difficult to see how such a denial could be compatible with physicalism.) It rather claims that we really shall not and cannot reduce our mentalistic predicates to physicalistic predicates. One might object that by weakening the thesis of nonreducibility in this way, NRP is rendered a purely epistemological and thus uninteresting doctrine. For on this weaker view, the nonreducibility of mentalistic predicates is not explained by mental properties and physical properties being in different ontological categories; there is no reason to assume that mental properties are in any ontologically significant sense on a "higher level," nor that they in any ontologically significant sense "emerge" from physical properties. Rather, the weaker view suggests that the nonreducibility of mentalistic predicates is purely due to our own epistemological limitations. But, first,

I do not think this is an objection so much as it is a clarification of what a plausible version of NRP must claim; NRP, properly understood, is primarily an epistemological doctrine. It alleges that the theories and predicates of the special sciences never will in fact be reduced to physical theory. And, second, even this weaker version of NRP ought to satisfy psychologists, economists, and nonreduction-minded philosophers: on this weaker conception of NRP, generalizations expressed in terms of mentalistic predicates can be supported by evidence, and can support counterfactuals. Thus there is no special reason to doubt the existence of psychological, economic, and such laws. Consequently, even on this weaker conception, psychology and the other special sciences are guaranteed autonomy from physics, though, like physics, they are by no means guaranteed to be successful.

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