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CONSTRUCTIVAL PLASTICITY

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It is often said that a given mental property can be subserved by any number of distinct physical state types.[1] But there is also an interesting converse to this claim which invites our attention, namely, that a given physical property can serve to realize any number of distinct mental types. The first is the commonplace idea that *mental properties have compositional plasticity*, a claim championed by functionalists and dualists alike. But the second is a lesser known and rarely mentioned idea that, as I shall put it, *physical properties have constructival plasticity*.[2] To illustrate the difference, the property of being a building has compositional plasticity in the sense that things of this type can be made or composed of various substances (brick, stone, wood, metal, etc.); being a brick, on the other hand, can be described as having constructival plasticity in the sense that things of this type can be used to make up or construct various other things (a building, wall, patio, road, etc.).

Both compositional and constructival plasticity provide the basis for differing concepts of mind/body relations, and of intertheoretic relations quite generally, and it is my intention to explicate these notions and explore their consequences for certain issues in the metaphysics of mind. Not all this work will be "conceptual landscaping," however, though a good map of the logical terrain is much needed. For constructival plasticity lends itself to various interpretations, some deeply problematic and others not.

I. MULTIPLE REALIZATION, WEAK AND STRONG

A. *Multiple Realization*

Let us begin with the familiar notion of compositional plasticity, so that we may later effect the proper contrast with constructival plasticity.

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This particular notion derives from the functionalist literature concerning the multiple realization of mental properties by the physical.[3] The basic idea entails at least this: that a given property could be realized in virtue of others, and that this realization could be accomplished in different ways. Moreover, it is an intertheoretic notion which relates the properties of a higher-level theory to those of a suitably lower-level domain.[4] I suggest the following, where A is a set of properties from a higher-level theory, and B is a set of properties from a more basic theory which constitutes the realization base for A:

(MR) a set of properties A is subject to multiple realization in a set B iff, for every F in A, there exist distinct properties G and H in B such that,
  (i) possibly some object instantiates F in virtue of G but not H; and
  (ii) possibly some object instantiates F in virtue of H but not G.[5]

I have left it open whether the objects referred to in the respective clauses are the same (e.g., Sally might have had pain realized by something other than her neurophysiology, or this might have been true of some other physically dissimilar creature, say, an extraterrestrial having pain like Sally's). I have also allowed that the objects may not exist in the same world, meaning that an object's having F in virtue of H might be a mere possibility relative to an object's having F in virtue of G (as Putnam made clear long ago, the variability of a mental type need only be possible *vis-à-vis* the way things now stand).[6] Similarly, I have given place for uninstantiated properties, since it need only be possible for an object to exemplify them. Finally, aside from the fact that the properties in A and B occur at different theoretical levels, as yet I have said nothing about the precise nature of those properties, whether they be simple or complex, functional or structural, or whatever (though the base properties are likely to be exceedingly complex, conjunctive or relational features — recall cases of wide individuation, or concerns which motivated regional and global supervenience). Even as the definition now stands, however, there are deep issues to be resolved. Foremost among them, the use of the "in virtue of" relation should be explained, and this is no small task — witness the perennial

debates over a family of closely associated notions, chiefly, the nature of explanation, causation, dependency, determination, and supervenience. Here I will leave the relation undefined, counting (MR) as a preliminary concept only, and then return to the topic momentarily when I offer various refinements which lead in quite different directions.

Be that as it may, how does the above concept relate to the *compositional plasticity of mind*? I think we can stipulate that if A is the set of mental properties and B the set of physical properties, then (MR) expresses the desired feature. This is acceptable, I think, with one proviso to accommodate the possibility of nonphysical realizations.[7] In that case, the properties G and H in B might be nonphysical substance types; and if the set of base properties is thus heterogeneous with respect to physical and nonphysical alike, this will create a more extreme version of compositional plasticity whereby the mental is not essentially tied to the physical at all. For present purposes, however, we can make the simplifying assumption that B has only physical properties as members.

B. *The Direction of Variability in (MR)*

Notice that the relation defined by (MR) is "one-many" in the direction of A to B. In the psychophysical case, what we want is a claim about *mental* properties — that a given mental property can be multiply realized by various and sundry physical states. This is the standard, orthodox position; and so understood, *there is no corresponding claim about physical properties*. That is a crucial point about our core concept of multiple realization. That is to say, (MR) is completely silent about whether the base properties in the set B are such that each one could serve to realize an indefinite range of properties in A, which is just to say that our preliminary concept does not address the notion of constructival plasticity alluded to at the outset of this paper. Indeed, it is perfectly consistent that (MR) be true and that each property in B serves to realize one and only one property in A. That is, the realization base for F in A might be a subset s in B that includes properties G, H, . . . ; and the realization base for another property E in A might be a subset t in B that includes properties I, J, . . . , where s and t share no members whatsoever — even if s and t have infinitely many members).

Whether the individual properties in *A* enjoy this type of exclusivity with respect to their realization bases in the set *B* depends entirely upon the kind and strength of the relation between the respective sets of properties.

Before we turn to that topic, however, let me summarize matters thus far by saying that, with respect to the issue of variability, the concept of multiple realization expressed by (MR) is "unidirectional" from *A* to *B*, or, if you will, from mind to matter (if our concern is with determination or dependency rather than the variability of realization, then of course the direction goes in the other way). For here we are trying to discern the nature of the compositional plasticity of mind, and that, considered in and of itself, is a one-many relationship from the mental to the physical. Nothing contentious here. A mere expansion on the philosopher's term of art. True, we may want more from our metaphysics of mind. Henceforth we will tread on more controversial ground.

C. *The Strength of the Relation*

Now to address the "in virtue of" relation which plays a critical role within the definition (MR). Let me say emphatically that I do not intend to provide an analysis of what "in virtue of" *means*. If there is any analysis at all, it is of the wider context "__ instantiates . . . in virtue of . . ." (perhaps more judiciously described as replacing the "in virtue of" relation with other more manageable notions). Yet I think it is safe to say that when an object instantiates a property in virtue of another, it should entail, minimally, that the instantiation of the one is somehow dependent on the other or determined by it. Nevertheless, there may be reasons to prescribe a weaker relation that carries no modal force, for example, reasons grounded in a commitment to anomalous monism, weak or global supervenience, issues that will surface later. Hence, in order to leave all avenues open at this point, we can take (MR) in at least two directions. The first provides a *de facto* or *accidental* correlation between the multiply realized property and those in its realization base. I will call this "weak multiple realization":

(MR_w) a set of properties *A* is subject to weak multiple realization

in a set B iff, for every F in A, there exist distinct properties G and H in B such that,

(i) possibly some object has F, and it has G but not H, and everything that has G has F; and

(ii) possibly some object has F, and it has H but not G, and everything that has H has F.

The second version stipulates that the multiply realized property be *necessitated* by those in its realization base. Call this "strong multiple realization":

(MR_s) a set of properties A is subject to strong multiple realization in a set B iff, for every F in A, there exist distinct properties G and H in B such that,

(i) possibly some object has F, and it has G but not H, and, necessarily, everything that has G has F; and

(ii) possibly some object has F, and it has H but not G, and, necessarily, everything that has H has F.

The similarity between weak and strong multiple realization and Jaegwon Kim's definitions of weak and strong supervenience should not go unnoticed.[8] Crudely put, the above definitions incorporate the determinative relations of weak and strong supervenience, respectively, *plus* the claim that property F can be correlated with (in the case of weak) or necessitated by (in the case of strong) certain properties *other than* G — the latter being the essential element of variability or plasticity which sets multiple realization apart as a distinct and important notion in the philosophy of mind. More precisely, the left-hand sides of (i) and (ii) jointly express the possibility of an alternate realization, while the right-hand sides jointly express the conditions for realization itself, namely, the *de facto* sufficiency (weak) or determination (strong) of the multiply realized property by the alternate base properties in the set B. Specifically, like weak supervenience, weak multiple realization does not require that each property in A be necessitated by a property in B. It is consistent with (MR_w) that an object's having G gives rise to its having F in one world and yet fails to give rise to its having F in another.[9] Not so for the strong variety. Like strong supervenience, strong multiple realization carries with it the implication that, for each

F in *A*, there is a property *G* in *B* which determines it across worlds. Of course, the precise reading we give to the modal term "necessarily" which occurs in (MR_s) might depend upon our metaphysical commitment for the particular area in question, be it the realization of a moral property by the nonmoral, psychological by the physical, and so on. At this juncture we need only note that the various interpretations of necessity — causal, nomological, metaphysical, even logical — will generate distinct senses of strong multiple realization.

Finally, I should say a few words about compositional plasticity, so defined, and the issue of intertheoretic reduction. Most philosophers believe that the phenomenon of multiple realization prevents reduction of a particular sort, namely, that which proceeds *via* lawful coextensions or type-identities.[10] But consider (MR_s), the stronger determinative relation. The implication for irreducibility is this: though the base property *G* determines *F* by clause (i), it cannot be identified with *F* given the possibility described by (ii) that *F* may occur without *G*; and similarly for the base property *H*. Both *G* and *H* are individually sufficient, but neither supplies a necessary condition. Consequently, while the above definition invokes modally strong conditionals of the form "necessarily, $G \Rightarrow F$," it forbids the pertinent biconditional "necessarily, $F \Leftrightarrow G$" that would justify the identification of properties. More generally, then, *no property in terms of which a higher-level type is multiply realized can be identified with that higher-level type.* Nonetheless, it is perfectly consistent with what has just been said that there exists some *other* lower-level property distinct from *G* and *H* that is both necessary and sufficient for *F*.[11] In order to rule this out, we would need to add a third condition: (iii) there is no other property *K* in the set *B* such that, necessarily, everything has *F* if and only if it has *K*.

The net result is that we have a modest core concept circumscribed by (i) and (ii), ecumenical in spirit with regard to the weightier issues of reduction, and a more austere anti-reductionist concept determined by the addition of (iii). Now I do in fact accept (iii) for an important range of higher-level types, most notably the psychological *vis-à-vis* the physical. But for present purposes I think it is particularly advantageous to separate out the variability conditions (i) and (ii) from any anti-reductionist condition like (iii). For one, the latter would generate needless controversy, seeing that a physicalist might opt for a sense of

multiple realization consistent with the reduction of at least some higher-level types. Moreover, even a complete nonreductivist in matters of psychology might find the application of (iii) unwarranted in other domains, specifically in cases where a property *F* is multiply realized with respect to some but not all the properties in the set *B*.[12] In any event, the variability of (i) and (ii) is our main focus, since it is that aspect of multiple realization which provides a stark contrast with the notion of constructival plasticity, to which we now turn.

II. CONSTUCTIVAL PLASTICITY

A. *Initial Formulations*

We now examine a different notion altogether, what I have labeled "constructival plasticity." The question is this: what if it is true not only that a given mental property can be multiply realized by various physical states, *but also true that a given physical property can serve to realize a multiplicity of mental states*? No definition of this latter concept can be found in the literature. Here I want to remedy that situation by exploring various ways in which it can be construed. To begin, though constructival plasticity has not been part of the common lore about multiple realization (the focus has been on the compositional plasticity of the mind), yet some philosophers have referred to it on occasion. Thus, Ned Block and Jerry Fodor make passing reference to the notion while arguing against the use of disjunctive properties in the context of reduction. They claim there is no reason to believe the disjunctions will be distinct on grounds that:

> [P]ractically any type of physical state could realize practically any type of psychological state in some kind of physical system or other . . . a theory which says that each psychological predicate is coextensive with a distinct disjunction of behavioral (or physical) predicates is incompatible with what we have been assuming is an obvious truth: namely, that a given behavioral state may express (or a given physical state may realize) different psychological states at different times.[13]

The argument which follows this initial appeal to constructival plasticity is a bit lengthy, and need not detain us here.[14] It is enough to note that Block and Fodor accept some form of constructival plasticity — in their words, that "practically any type of physical state could

realize practically any type of psychological state," depending on the system and time in question. Indeed, we are told it is "an obvious truth," so obvious that it remained an unanalyzed and unargued assumption in their paper. Moreover, Block and Fodor are not alone in their support for this seemingly innocuous doctrine. Cynthia Macdonald has given a similar argument against disjunctive properties which also invokes constructival plasticity. About this plasticity she says:

> [N]o physical type for which it is logically possible that it serve as a member of a disjunctive physical type can be excluded from *any* of the disjunctions with which mental types are to be identified.[15]

And more recently Macdonald makes the same claim in terms of what is metaphysically possible:

> Given, moreover, that it is metaphysically possible that one and the same physical property might realize in distinct individuals *distinct* mental ones, no physical type for which it is metaphysically possible that it serve as a member of a disjunctive property with which a given mental property is to be identified can be prohibited from serving as a member of any disjunctive physical property associated with any *other* mental property.[16]

Finally, the idea of one and the same physical property subserving distinct higher-level types is not confined to psychophysical relations. David Hull sees constructival plasticity in the relation between Mendelian and molecular genetics. As he puts it: "the same types of molecular mechanism can produce phenomena that must be characterized by different Mendelian predicate terms."[17] Constructival plasticity therefore appears to have application across various domains (as my initial example of bricks and buildings will attest). How should we construe this notion of plasticity? Let us begin in a way that parallels our definition (MR):

(CP) a set of properties B has constructival plasticity in a set A iff, for every G in B, there exist distinct properties F and E in A such that,
- (i) possibly some object instantiates F but not E in virtue of G; and
- (ii) possibly some object instantiates E but not F in virtue of G.

Compare this to our initial definition of multiple realization, the core concept aimed to capture the compositional plasticity of the mind:

(MR) a set of properties A is subject to multiple realization in a set B iff, for every F in A, there exist distinct properties G and H in B such that,
  (i) possibly some object instantiates F in virtue of G but not H; and
  (ii) possibly some object instantiates F in virtue of H but not G.

Intuitively, what we want from the notion of constructival plasticity is something which approximates the inverse of compositional plasticity in roughly the way that the plasticity of a brick *vis-à-vis* the various things it can be used to construct approximates the inverse of the plasticity of a building *vis-à-vis* the various substances of which it can be composed. (CP) seems to fit the bill. Both (MR) and (CP) agree that some object might have F in virtue of G; but (MR) says it is possible that an object has F in virtue of a property *other than* G, while (CP) says it is possible that an object has a property *other than* F in virtue of G. So far so good.

All the same, I did not accurately represent the previous claims about constructival plasticity. In the hands of Block and Fodor, and also Macdonald, the notion of constructival plasticity takes on a *broader scope* than what is expressed by (CP). Block and Fodor said in the above quotation that "practically any type of physical state could realize practically any type of psychological state," and Macdonald remarked that no physical type "can be excluded from *any* of the disjunctions with which mental types are to be identified." This implies that *every* property in A, not just some F and E, is such that it could be subserved by a given property G in B. In psychophysical terms, what this means is that a physical property can serve to realize any mental type whatsoever! This creates a significant disanalogy with the claim about compositional plasticity. For I assume it is not commonly thought to be an integral part of the plasticity of mind that a given mental property could be subserved by *any* physical type in the set of base properties, only that it could be subserved by *others* in such a way as to create the variability of a one-many relationship. But in order to

accommodate Block, Fodor, and Macdonald's more far reaching claim about constructival plasticity, and because their claim is in my view more interesting on account of its generality, we will modify (CP) accordingly — call it the extreme version:

(CP_x) a set of properties *B* has constructival plasticity in a set *A*, iff, for every *G* in *B*, and for any distinct properties *F* and *E* in *A*,
- (i) possibly some object instantiates *F* but not *E* in virtue of *G*; and
- (ii) possibly some object instantiates *E* but not *F* in virtue of *G*.

B. *Some Pitfalls for a Strong Reading*

But we have yet to offer any explication of the context "__ instantiates . . . in virtue of . . ." as it occurs within (CP_x). Suppose we attempt both a weak and strong reading which mirrors our variations on (MR). We start with weak constructival plasticity:

(CP_w) a set of properties *B* has weak constructival plasticity in a set *A* iff, for every *G* in *B*, and any distinct properties *F* and *E* in *A*,
- (i) possibly some object has *F* but not *E*, and it has *G*, and everything that has *G* has *F*; and
- (ii) possibly some object has *E* but not *F*, and it has *G*, and everything that has *G* has *E*.

Strong constructival plasticity would then be:

(CP_s) a set of properties *B* has strong constructival plasticity in a set *A* iff, for every *G* in *B*, and any distinct properties *F* and *E* in *A*,
- (i) possibly some object has *F* but not *E*, and it has *G*, and, necessarily, everything that has *G* has *F*; and
- (ii) possibly some object has *E* but not *F*, and it has *G*, and, necessarily, everything that has *G* has *E*.

Yet there is serious trouble. Consider (CP_s). It is formally incon-

sistent. For example, once we invoke the conditional "necessarily, $G \Rightarrow F$" to explain the instantiation of F in virtue of G, as in the right-hand side of clause (i) and consonant with the strong readings throughout, then we can no longer say that the base property G could serve to realize some other property *in the place of* F, as in the left-hand side of clause (ii). That is to say, "necessarily, everything that has G has F" and "possibly some object has E *but not* F, and it has G," are contradictory (at least under certain natural assumptions about the accessibility relation between these worlds).[18] This exposes a certain tension which I think runs deep within the notion of constructival plasticity — *a tension between the condition under which one property subserves another versus the possibility that the same base property subserves yet another higher-level type altogether.* If, for instance, the condition under which C-fibers subserve pain is that there should be a modally strong relation between them, that C-fiber firing determines pain crossworldly speaking, then this fact *precludes* C-fibers of that type from occurring without pain when, according to the notion of constructival plasticity, they might give rise to something else, say, a pleasure (that the notion of one property subserving another *should* be explicated in terms of a modally strong relation is briefly argued for in sec. III.A.).

Could we make our definition consistent by simply dropping the denial "not F" on the left side of clause (ii) so that it reads: "possibly some object has E, and it has G" (and similarly for clause (i), etc.)? But from the aforementioned conditional alone we may *deduce* that if an object has G, it must have F, a fact which again precludes any object from ever realizing an alternative to F when it exemplifies G. It follows, curiously enough, that if an object has property G, then properties F and E must be *coinstantiated* — a rather attenuated notion of plasticity, to put it lightly, which should not satisfy our expectations concerning what it means for one and the same property to subserve distinct higher-level types. (Cf. in this regard (MR_s). There is no inconsistency between "necessarily, everything that has G has F," and "possibly some object has F, and it has H *but not* G." The alternate property, in this case the base property, is therefore permitted to be a genuine alternative.)

This untoward result that properties F and E must be coinstantiated, given G, can be approached from a different direction. Ignore the

aforementioned inconsistency or any tampering with the denials on the left-hand side of clauses (i) and (ii) to set matters straight. Consider just the correlations on the right. We have two conditionals "necessarily, $G \Rightarrow F$" and "necessarily, $G \Rightarrow E$" to explain the instantiation of F and E in virtue of the same base property G. But for a wide range of properties we simply cannot maintain both conditionals at once. More precisely, they are inconsistent on the assumption that F and E are *distinct properties that cannot be coinstantiated*, an assumption which is quite natural and true for a large number of properties we might want to include in the set A.

Again, if we are concerned with psychological types, the conditional in clause (i) might be "necessarily, everything that has C-fibers fire has pain," and the conditional in clause (ii) might be "necessarily, everything that has C-fibers fire has pleasure," the joint assertion of which I take to be false. If one counters that a person might have pain and pleasure at once, this is not always true; and, in any case, persons are not sufficiently fine-grained for the purposes of psychological theorizing. We also want to talk about mental states or events. So let the objects in the domain of discourse be *mental state tokens* rather than *persons* and alter the predicates accordingly (not "has pain" but "is pain"). I take it that instances of pain cannot also be instances of pleasure, token thoughts of Vienna cannot also be token thoughts of Ann Arbor, belief that it is raining cannot be belief that it is not raining, and so on.[19]

My aim is not to deny that a given base property might serve to realize *some* distinct higher-level types in the innocuous sense illustrated by the microstructure of water giving rise both to its "translucence" and "conductivity," or the physical movement of a body exemplifying both a "walking" and a "travelling," or certain programed heuristics determining an entire set of mental contents in a global fashion such as "wanting to get the queen out early" and "preferring a wide open game."[20] For (a) this is not the kind of variability intended by a doctrine of constructival plasticity inasmuch as the distinct properties are not envisioned to be genuine alternatives, that is, an object having F but not E, or E but not F; (b) the properties illustrated in these latter cases are of such a nature as to allow for coinstantiation required by the universal conditionals in (CP_s), meaning that "neces-

sarily, everything that is (pure) H_2O is translucent," and "necessarily, everything that is (pure) H_2O conducts electricity" are compatible in a way that the aforementioned conditionals about pain and pleasure are not; and (c) the sense of alternate properties I want, that is, an object having *F* but not *E*, or *E* but not *F*, is precisely the sense that would parallel (MR), where an object has *G* but not *H*, or *H* but not *G*.

All of this may encourage a retreat to the weaker reading of constructival plasticity, (CP_w). How does it fare with respect to the problems just canvassed? Happily, the fact that its conditionals carry no modal force resolves any contradiction. For example, the right-hand side of clause (i) and the left-hand side of clause (ii) are not formally inconsistent since the possibility of a *de facto* correlation "$G \Rightarrow F$" does not contradict the possibility of an alternate realization, the statement "possibly some object has *E* but not *F*, and it has *G*." That is, we need not assume that the correlations "$G \Rightarrow F$" of (i) and "$G \Rightarrow E$" of (ii) hold in the same worlds, and thus run afoul of the countless higher-level properties that cannot be coinstantiated by the same state tokens. On the other hand, I will argue later that we should not accept any weak reading, all things being equal, since the conditionals carry no modal force and so will fail to capture the idea that higher-level types depend in some sense upon their lower-level base properties. Hence, it might be wise to consider how a strong reading can be preserved.

C. *Possible Resolutions*

There are basically two ways we might attempt to avoid the coinstantiation problem for a modally strong reading, at least given the notion of constructival plasticity we are operating with thus far. First, *alter the modalities* so that the correlations need not hold at the same world. And second, retreat to a claim about *some* rather than all the properties in the pertinent sets. The latter actually invites a return to our original version (CP). For (CP) involves the claim that only *some* properties *F* and *E* in *A* are such that a given property *G* in *B* may subserve them. This avoids the problem of coinstantiation since it is unreasonable to assume that *all* properties in the set *A* cannot be exemplified by the same state tokens (even though, as I have argued,

countless properties are incompatible in precisely that sense). On the other hand, the drawback of invoking only those properties in A that can be coinstantiated is that the strategy will issue in a fairly attenuated sense of constructival plasticity, as I mentioned already. For we have seen that F and E cannot be pains and pleasures, or thoughts of Vienna and thoughts of Ann Arbor, and so on. A different modification is therefore desirable.

So consider the other way to avoid the coinstantiation problem, namely, altering the modalities so that the correlations will not hold at the same world. The most fruitful suggestion in this regard, I think, is simply to stipulate that the conditionals in (CP_s) express, not metaphysical, but a lesser nomic necessity. Call the result "mild constructival plasticity":

(CP_m) a set of properties B has mild constructival plasticity in a set A iff, for every G in B, and any distinct properties F and E in A,

(i) possibly some object has F but not E, and it has G, and, necessarily (nomic), everything that has G has F; and

(ii) possibly some object has E but not F, and it has G, and, necessarily (nomic), everything that has G has E.

This construal avoids any inconsistency since we need not assume the possible worlds picked out by (i) and (ii) are the same; nor, more importantly, should we assume that the accessibility relation which underlies these weaker modalities will connect those worlds. There is a world where some object has F, and a law $G \Rightarrow F$ holds to explain the instantiation of that property, and there is a world where some object has E, and a different law $G \Rightarrow E$ holds to explain that instantiation, and there is no reason to assume that the laws governing the one world will govern the other. Here, then, is a clear sense in which one and the same base property could determine distinct higher-level types.[21]

Nevertheless (CP_m) may appear too weak to some and too strong to others. Taking stock of general metaphysical commitments, those who accept a robust determinative relation like strong supervenience might also accept the determination of A properties by B across all metaphysically possible worlds (subject, of course, to choice of domain —

e.g., what we might want to say about the psychophysical case we might not want to say about the moral/nonmoral case, etc.).[22] In other words, why settle for the lesser nomic necessity which mild constructival plasticity employs? After all, causation is not at issue. The relation between higher and lower-level types should not be patterned after the interaction of entities from domains having equal status. On the other hand, those who reject property-to-property determinations across possible worlds, for instance, anomalous monists in the psychophysical case, those who give a cross-world reading to inverted spectra and absent qualia, and defenders of weak and global supervenience more generally, will resist our mild reading. Hence we must consider, if only briefly, the broader metaphysical issues. I will then return to the notion of constructival plasticity, the aim being to capture some sense in which even the most stringent metaphysical necessity can underlie the alternate realizations.

III. FINAL CONSIDERATIONS

A. *Subservience and Supervenience*

I have taken the idea of one property subserving another or being realized in virtue of another in quite different directions — at the one end a weak correlation between the properties, at the other a modally strong relation. Which concepts have application to the real world? Here I have no compelling answer, and opinions are likely to differ. But general metaphysical considerations (or biases) should intrude at this point. To wit, I think the stronger determinative relation is to be preferred. Certainly many philosophers have thought that the relation between multiply realized properties and those in their realization base should entail some form of necessity. Thus, Jaegwon Kim argued some time ago that the very notion of a "physical realization" presupposes the existence of nomological connections between the mental and underlying physical types.[23] And more recently, Ernest Lepore and Barry Loewer appeal to physical necessity within a broad system of explanation as a way of spelling out the conditions under which one property subserves another. They say:

> The usual conception is that e's being G realizes e's being F iff e is G and e is F and there is a strong connection of some sort between G and F. We propose to understand this connection as a *necessary connection* which is *explanatory*. The existence of an explanatory connection between two properties is stronger than the claim that $G \Rightarrow F$ is physically necessary since not every physically necessary connection is explanatory. For e's being G to explain its being F it may be necessary that there be a system of connections between realized and realizing properties of property kinds to which G and F belong.[24]

Finally, Stephen Yablo invokes metaphysical necessity in his recent definition of multiple realization: "Necessarily, for every mental property M, and every physical property P which *necessitates* M, possibly something possesses M but not P."[25] Why appeal to a form of necessity? Surely the fact that property F is subserved or instantiated in virtue of G ought to be supported by the appropriate counterfactuals and subjunctives.[26] Hence, the sum of the matter is that any weak reading of plasticity, be it weak multiple realization or a weak form of constructival plasticity, will violate our intuitions concerning what it means for one property to be realized in virtue of another. They fail to do justice to the subservience of properties.

Consider now supervenience, the more general metaphysical relation between families of properties. Strong supervenience (see again n. 8) implies a certain principle of property-to-property determination, which we can formulate as follows: "for every property F in A there is a property G in B such that, necessarily, if an object has G then it has F." What is significant is that only our strong and mild forms of plasticity respect this principle (and not even the mild if the above principle is not unduly restricted to the nomologically possible worlds for each and every case of inter-level relation). The conditionals employed by weak multiple realization lack the requisite modal force. Worse still, the variations on weak constructival plasticity are flatly inconsistent with strong supervenience given two previously mentioned assumptions: first, that the determinative relations between the properties in A and B hold across other possible worlds (even in the psychophysical case I am inclined to say this is true — if there are qualms about qualia, we can restrict our attention to the propositional attitudes); and second, that it is not generally true that a given property G in B can determine two distinct properties F and E in A (since they are often incompatible, i.e., the problem of coinstantiation). Consequently, *if* we accept strong

supervenience, a welcome theoretical economy is effected — we can pitch the weak forms of plasticity gathered along the way, that is, (MR_w) and (CP_w).

Indeed, though this is terribly contentious, it does seem to me that strong supervenience is preferable over its competitors: the weak and global varieties. The arguments are familiar. Both weak and global supervenience fail to capture the physicalist intuition (or even the property dualist and emergentist intuitions) that the mental is somehow determined by the physical. Weak supervenience is too weak, seeing that its *de facto* correlations do not support counterfactuals; and global supervenience is too permissive, seeing that it lacks the property-to-property correlations of strong supervenience and so permits unrelated and isolated instances of phenomena in the set *B* to generate wildly different instances of phenomena from the set *A*.[27] So my admittedly partisan conclusion is this — considerations about the subservience of properties where one property realizes another, and general considerations about supervenience between families of properties, should force us in the direction of plasticities which issue in counterfactually supporting inter-level relations. Hence, given the difficulty with (CP_s) noted earlier, only (MR_s) and (CP_m) appear to survive our analysis.

B. *Constructival Plasticity Again*

Yet I do not think (CP_m) represents the only viable notion of constructival plasticity. Note that, like the other definitions, mild constructival plasticity does not express the fact that the relation holds at *our* world. It only says the variability is possible, not actual. More importantly, given the problem of coinstantiation discussed earlier, we have yet to specify a sense in which each of the alternate realizations picked out by clauses (i) and (ii) can occur in the *same* world. But this is something I think we should want to say. Unfortunately, if we drop the possibility operators trouble will ensue. We cannot have clause (i) read: "some object has *F* but not *E*, and it has *G* . . . ," and the same for clause (ii), since that would require the object actually to *have* the properties in question, ruling out incompatible types. Nor can we avoid the trouble by putting matters *hypothetically*, saying: "*if* some object has *F* but not *E* . . . ," and so on. For without the initial possibility operators which

have the entire clauses (i) and (ii) as their scope, our coinstantiation problem returns with a vengeance — the conditionals hold intra-worldly speaking, so that even the accidental correlations $G \Rightarrow F$ and $G \Rightarrow E$ could not be maintained for countless properties we want to include in the relevant sets. Is there any way out of this quandary? My solution is to break with our previous definitions and *abandon the idea that the base property which enjoys variability is the same property that suffices to bring about the higher-level types.* This needs some explaining.

What do we imagine when we imagine constructival plasticity? In the psychophysical case perhaps we picture to ourselves a types of brain event, for example, the activation of C-fibers which happen to instantiate pain, and then we imagine the brain being so rewired that the same kind of C-fiber firing would subserve something else, a pleasure, a tickle, or thought of Vienna. Suppose this is so. Can we accept such obvious facts and still invoke modally strong relations in explicating the subservience of properties and yet avoid the pitfalls of inconsistency and coinstantiation that plagued our earlier construal of strong constructival plasticity? Yes. Consider again what we just imagined about C-fibers. Simply put, what seems true about constructival plasticity is this: one physical state type like C-fiber firing *in relation to other physical state types* will give rise to pain, but, when *differently situated in relation to still other physical state types* will give rise to pleasure. (Notice how natural it was to say a moment ago that the brain must be "rewired" to allow that the same kind of C-fiber firing could subserve something else. Indeed, we must appeal to some difference in contextual setting or relational features, otherwise we belie an even more fundamental intuition behind every form of supervenience — that there can be no difference without a physical difference!)

Utilizing these differences, let us say more formally that "P_1" is the type of C-fiber firing, "P_2" the other state types and contextual features referred to on the occasion of pain, "P_3" the quite different state types and contextual features referred to on the occasion of pleasure, "F" pain, and "E" pleasure. We can then maintain the following determinative relations: "necessarily, $(P_1 \ \& \ P_2) \Rightarrow F$," and "necessarily, $(P_1 \ \& \ P_3) \Rightarrow E$," where the original P_1 jointly contributes with other properties in the realization of distinct higher-level types. The conditionals are

sanctioned by strong supervenience. More than that, they do not issue in any coinstantiation problem, given their difference in antecedents. For what was objectionable is that the *same type* could determine distinct and incompatible properties. But here we have no such problem. Hence, the sum of the matter is that the variability of P_1 *vis-à-vis* F and E need not affect the necessitation of those properties by their more complex base properties so that, what is really sufficient for the realization of F, namely, P_1 *and* P_2, cannot occur without F, and what is really sufficient for E, namely, P_1 *and* P_3, cannot occur without E. Parenthetically, since P_1 is an insufficient condition for the realization of F (and the same for E), and given the facts of compositional plasticity according to which the complex properties that include P_1 are not necessary but in themselves sufficient for those higher-level types, then P_1 turns out to be an INUS condition: an insufficient but necessary part of an unnecessary but sufficient condition for the realization of higher-level types.

Elsewhere I have described the difference between P_1 and the wider contextual features in terms of Sydney Shoemaker's distinction between "core" and "total" realizations.[28] Following David Lewis, with some modification, Shoemaker explains that if T is a higher-level theory like psychology, the Ramsey sentence for T can be written as an existentially quantified formula "$\exists F_1 \ldots \exists F_n\ [T(F_1 \ldots F_n)]$," where "$F_1$" represents a psychological type like pain, now situated in the context of other states in relation to which pain interacts according to T. Pain, then, can be viewed as the functional property determined by the open sentence "$\exists F_1 \ldots \exists F_n\ [T(F_1 \ldots F_n)\ \&\ x$ has $F_1]$." A lower-level *physical* property which realizes pain is then determined by substituting in a set of physical predicates "$P_1 \ldots P_n$" true of some individual when it is described by T, that is, "$T(P_1 \ldots P_n)\ \&\ x$ has P_1." For our purposes, each alternate base property in the set B will consequently be determined by a different set of physical predicates that could be satisfied by an individual if they were to be described by T.

So consider the predicate "$T(P_1 \ldots P_n)\ \&\ x$ has P_1" that we obtain by substituting a set of physical predicates into the open Ramsey sentence. My point can now be put as follows: it is not "P_1," say, C-fibers firing *taken alone* that is sufficient for the realization of pain, but rather the property expressed by the entire predicate "$T(P_1 \ldots P_n)\ \&\ x$

has P_1," the total realization *C-fibers-firing-as-embedded-in-a-network-of-other-physical-types*. In a word, no physical type subserves mentality in isolation, as if a solitary C-fiber could instantiate pain, or even a group of them firing with the appropriate rate — picture them in a lab dish, for example. But this is precisely the kind of picture I suspect we had in mind when we imagined the phenomenon of constructival plasticity, abstracting away the core from the total, and then imaginatively placing these states within different total realizations.

In fact, this point about core versus total realizations applies outside psychofunctional theory too. Consider our analogy of buildings and bricks. Being a brick, I said, has constructival plasticity in the sense that things of this type can serve to construct various other things. Yet a brick does not realize a building! It takes countless bricks joined together, just as it takes countless neurons working together within a system whose internal states are relationally specified in light of their function to realize mentality. Hence we may now offer an explication of constructival plasticity which acknowledges the insufficiency of the core realization (here "P_1"), the sufficiency of a wider property of which it is a part (here the simpler "P_1 & P_2" and "P_1 & P_3"), the role of modally strong conditionals in the subservience of properties, and all of this consistent with the variability of clauses (i) and (ii) occurring at the same world. Call it constructival plasticity, "strong and preferred":

(CP_{sp}) a set of properties B has constructival plasticity in a set A iff, for any distinct properties F and E in A, there exist distinct properties P_1, P_2, P_3 in B such that,

(i) if some object has F but not E, and it has P_1 (and P_2), then, necessarily, everything that has P_1 and P_2 has F; and

(ii) if some object has E but not F, and it has P_1 (and P_3), then, necessarily, everything that has P_1 and P_3 has E.

Again, what is striking about this form of constructival plasticity, in contrast to the others, is that each base property P_1, which enjoys variability with respect to F and E is not, strictly speaking, the property which subserves the higher-level types, at least not in the sense of being sufficient for their realization — which is precisely the sense at issue.[29] Hence, on *this* construal, Block and Fodor are wrong to say "a given

physical state may realize different psychological states at different times" (n. 13), and Macdonald is wrong to say "it is metaphysically possible that one and the same physical property might realize in distinct individuals distinct mental ones" (n. 16), and Hull is wrong to say "the same types of molecular mechanism can produce phenomena that must be characterized by different Mendelian predicate terms" (n. 17). Why? Because it is not the *same* physical property which subserves the differing higher-level types. In the case described by clause (i) it is the property (P_1 & P_2), and in the other cases described by clause (ii) it is the distinct property (P_1 & P_3), properties that should not be confused with P_1, the property which *is* the same on each occasion. This is the lesson of core versus total realizations, and the importance of context and relation.[30]

NOTES

[1] Some matters of terminology. First, I will follow common practice and use "property" and "type" interchangeably. Second, in expressing the relation between multiply realized properties and those in their realization base, we could say that "a given property is realized or subserved by various other *state types*" or "by *state tokens of various types*" even though the former glosses over the role of tokens while the latter underemphasizes the role of types in virtue of which the said property is realized. I will speak of types, with the role of tokens understood.

[2] See Ned Block and Jerry Fodor, "What Psychological States Are Not", in Ned Block, ed., *Readings in the Philosophy of Psychology*, vol. 1 (Cambridge Mass.: Harvard University Press, 1980): 237—250, at pp. 239—240, where they use the notion as a key premise in an argument against type-reductionist strategies which invoke disjunctive properties. Also Cynthia Macdonald, *Mind-Body Identity Theories* (London: Routledge, 1989), pp. 37—38 and 205. Parenthetically, this distinction between compositional and constructival plasticity is *not* Richard Boyd's distinction between "compositional" and "configurational" plasticity, the latter being a kind of variability with respect to actual form rather than substance. See his "Materialism Without Reductionism: What Physicalism Does not Entail," in *Readings in Philosophy of Psychology*: 67—106, at pp. 87—88.

[3] The three classic pieces are: Hilary Putnam, "The Nature of Mental States," in *Mind, Language and Reality: Philosophical Papers*, vol. 2 (London: Cambridge University Press, 1975): 429—440; Jerry Fodor, "Special Sciences," in *Representations* (Cambridge Mass.: M.I.T. Press, 1981): 127—145; and Richard Boyd, "Materialism Without Reductionism: What Physicalism Does Not Entail," op. cit.

[4] Talk of different theoretical levels is, of course, common in the literature on mind. Good discussions can be found in J. R. Anderson, "Methodologies for Studying Human Knowledge," *The Behavioral and Brain Sciences* 10 (1987): 467—505; William Lycan, *Consciousness* (Cambridge Mass.: M.I.T. Press, 1987); and Kim Sterelny, *The Representational Theory of Mind* (London: Basil Blackwell, 1990), chap. 3.

[5] That (MR) is only the "basic idea" should be underscored. For an anonymous referee

has suggested, quite rightly in my view, that we might add a third condition: "(iii) there is no property K in the set B such that everything instantiating F does so in virtue of K." The point, I assume, is to ensure that the variability of (i) and (ii) is a deep fact which does not mask any underlying similarity within the realization base. And most importantly, it guarantees the irreducibility of A to B which many expect from the concept of multiple realization, seeing that the absence of any K whenever F is realized shows that F has no necessary and sufficient condition in the set B (though properties like G and H are presumably sufficient). In fact, I have stipulated elsewhere that no sufficient condition may at the same time be necessary. See my "On Physical Multiple Realization," *Pacific Philosophical Quarterly* 70 (1989): 212—224, at p. 213. Nonetheless, I think it is best to leave (iii) in the background for the reasons discussed at the end of section I. C.

[6] Hilary Putnam, "Philosophy and Our Mental Life," in *Mind, Language and Reality: Philosophical Papers*, vol. 2, at p. 293.

[7] Many allow this possibility, e.g., Putnam, "The Nature of Mental States," pp. 435—436; Boyd, "Materialism Without Reductionism: What Physicalism Does Not Entail," pp. 92—97; and Sydney Shoemaker, "Some Varieties of Functionalism," in J. I. Biro and Robert W. Shahan, eds., *Mind, Brain, and Function* (Norman: University of Oklahoma Press, 1982): 93—120, at p. 98.

[8] Jaegwon Kim, "Concepts of Supervenience," *Philosophy and Phenomenological Research*, vol. 45 (1984): 153—176. Strong supervenience is defined as follows: a set of properties A strongly supervenes on another set B iff, necessarily, for each x and property F in A, if x has F, then there is a property G in B such that x has G, and necessarily if any y has G, it has F (for weak supervenience simply delete the last modal operator). It should be noted that, like weak and strong supervenience, our relations are *individualistic* in the sense that the base property which determines F is had by the same individual exemplifying F. This is notoriously problematic in cases of nonlocal determination. For suggestions, see Kim, "Psychophysical Supervenience," *Philosophical Studies* 41 (1981): 51—70. Alternately, we could formulate multiple realization in terms of *regions*, revising (i) and (ii) so that the object picked out by each clause belongs to a region having G (or H), and any region having G (or H) determines the object to have F. Cf. Terence Horgan "Supervenience and Microphysics," *Pacific Philosophical Quarterly* 63 (1982): 29—43; and his "From Supervenience to Superdupervenience: Meeting the Demands of a Material World," forthcoming in *Mind* (1993) sec. 5.

[9] Weak multiple realization of A in B is thus consistent with the possibility that an object has some other property E (not F) in virtue of G. This is weak constructival plasticity, a variable relation of B in A to be discussed in secs. II. A. and B. Nevertheless, these weak realizations still accord some primacy to the lower-level domain since there is still an important asymmetry between A and B properties: the conditionals, though weak, hold from the lower to the higher-level properties, but not vice versa; i.e., if some object has some other property E in virtue of G, it is because in that world the conditional "$G \Rightarrow E$" nonvacuously holds and not vice versa just like, in the case of weak multiple realization, the conditional "$G \Rightarrow F$" nonvacuously holds and not vice versa.

[10] Some philosophers claim that reduction does not require biconditional bridge laws. See, e.g., Robert Richardson, "Functionalism and Reduction," *Philosophy of Science* 46 (1979): 533—558, at pp. 547—549. But if the aim of reduction is the simplification of ontology *via* the identification of properties, then nothing less than lawful coextensions will serve this purpose. See Robert Causey, *Unity of Science* (Dordrecht: Holland: D. Reidel Publishing, 1977), chaps. 4 and 5; and Berent Enc, "In Defense of the Identity Theory," *Journal of Philosophy* 80 (1983): 279—298, at p. 280.

[11] See again n. 5. To illustrate the possibility in question, suppose we allow disjunctive properties. Then it is consistent with (i) and (ii) that the property G *or* H supplies a

necessary and sufficient condition for *F*. Yet I think there are compelling arguments against disjunctive properties. See D. M. Armstrong, *A Theory of Universals: Universals and Scientific Realism*, vol. II (London: Cambridge University Press, 1978), chap. 14; Paul Teller, "Comments on Kim's Paper," *Southern Journal of Philosophy* 22, Supplement (1983): 57—61; and David Owens, "Disjunctive Laws," *Analysis* 49 (1989): 197—202.

[12] For cases of this kind, see my "On Physical Multiple Realization," esp. pp. 216—218. Thus, suppose *F* is a domain-specific type like "temperature in an ideal gas," which has the lawful coextension *K*, "mean kinetic energy of molecules." Yet there can be distinct microphysical compositions *G* and *H* that subserve *F* in accordance with (i) and (ii), e.g., those that pick out the more complex properties of having mean kinetic energy within *this sort of molecular structure* as opposed to others (the example is from Kim, "Phenomenal Properties, Psychophysical Laws, and the Identity Theory," *Monist* 56 (1972): 177—192, at p. 190). Yet for doubts about domain-specific reduction in the area of psychology, see my "Species-Specific Properties and More Narrow Reductive Strategies," *Erkenntnis* 38 (1993): 303—321. Note also that another way to accommodate properties which are multiply realized with respect to some but not all the lower-level types is to accept the addition of (iii) but then restrict the set *B* so that it does not refer to all the types of the relevant theory.

[13] Block and Fodor, "What Psychological States Are Not," p. 239.

[14] Their argument, less formally, is this (ibid., pp. 239—240): given constructival plasticity, having C-fibers fire, e.g., could express pain at one time and pleasure at another. But then it would be a member of both disjunctive physical types coextensive with pain and pleasure. However, if each disjunct supplies a sufficient condition for the realization of its corresponding mental property, then *having C-fibers fire would realize both pain and pleasure at once* ("an organism in S_i is in both p_1 and p_2," they say). One result I establish in sec. II. B. is that the problem Block and Fodor describe has nothing to do with disjunction, but follows directly from the concept of constructival plasticity, given certain natural assumptions about modally strong conditions for realization.

[15] Cynthia Macdonald, *Mind-Body Identity Theories*, p. 38. Macdonald's argument is a variation on Block and Fodor's: given constructival plasticity, a physical property can subserve any mental type whatsoever. Then, allowing for disjunction, that selfsame physical property will occur as a member in each disjunctive physical property that correlates with a mental type. But if this is true about every physical property that serves to realize mentality, then each disjunctive physical property will share the same members, establishing the untoward result that mental properties are *indistinguishable.*

[16] Cynthia Macdonald, "Psychological Type-Type Reduction *Via* Disjunction," *Southern Journal of Philosophy* 30 (1991): 65—69, at p. 67. This was a response to my paper, "Macdonald on Type Reduction *Via* Disjunction," *Southern Journal of Philosophy* 29 (1991): 209—214. My criticisms were (a) that Macdonald wrongly cast her argument in terms of what is *logically* possible; (b) in the place where she defends what I call constructival plasticity she unfortunately cites *compositional* plasticity as her evidence, which does not entail the desired conclusion; and (c) multiple realization should involve the existence of one-way conditional *laws* which seem at odds with the claim about constructival plasticity. In her response Macdonald concedes (a); she does not address (b); and makes an excellent point about (c), viz., that I assumed "not only that some kind of supervenience relation holds . . . but that specific correlations between mental and single physical properties can be established compatibly with the possibility of variable realization of mental properties" (ibid., p. 68). I did assume a particular determinative relation, and reflecting on that assumption led to various points in this paper.

[17] David Hull, *Philosophy of Biological Science* (Englewood Cliffs, N.J.: Prentice-Hall, 1974), p. 39.

[18] That is, I assume that the accessibility relation which underlies the modalities will

require the pertinent worlds to be metaphysically possible to each other. This is true, of course, in system S5. The possible world W1 of clause (i) where "necessarily, $G \Rightarrow F$" holds is accessible to the possible world W2 of clause (ii) so that "$G \Rightarrow F$" holds there as well. And S5 to one side, to talk of accessibility is to demarcate a *relevant* set of worlds, and the notion of an "alternate realization" should include all and only those worlds that are relevant in the sense of being metaphysically possible. If, e.g., W2 were merely "logically" or "conceptually" possible relative to W1, this would generate no *interesting* sense in which there could be an alternate realization of the higher-level types by the same base property. Observe, however, that if the conditionals are taken to express *statistical probabilities*, then it would still be metaphysically possible (though perhaps extremely unlikely) for G to occur without F. Some suggest that psychophysical correlations should be understood in this way, given the nature of quantum physics. But I doubt that this indeterminacy expresses what we want about constructival plasticity. For we do not want the occurrence of the alternate property E in the place of F to be *random*, as if the determination of higher-level types is like the time at which the nucleus of an atom will decay.

[19] These remarks about consistency and coinstantiation hopefully clarify the statement I made in "Macdonald on Type Reduction *Via* Disjunction," at p. 212, that "a given physical type *determines a specific mental type*," and that, consequently, "it is hard to imagine how a given physical type could serve as a disjunct for just any given mental type."

[20] The first is taken from Harold Kincaid, "Supervenience Doesn't Entail Reducibility," *Southern Journal of Philosophy* 25 (1987): 343—356, at p. 349. The second is a familiar example from action theory. And the third is from Daniel Dennett, "A Cure for the Common Code," in *Brainstorms* (Cambridge Mass.: M.I.T. Press, 1978): 90—108, at p. 107.

[21] In light of my remarks about accessibility for strong readings (fn. 18), let me say that whereas a condition of relevance for the concept of an alternate realization should require that W1 of clause (i) and W2 of clause (ii) be *metaphysically* possible relative to each other, it does not in my view require that they be nomically possible. Hence, while the metaphysical necessity of $G \Rightarrow F$ which holds in W1 conflicts with the metaphysical possibility of an object having G and not F in W2, the nomic necessity of $G \Rightarrow F$ does not.

[22] Strong supervenience is thus a substantive thesis, to be sure. So understood, it rules against the metaphysical (but not logical) possibility of determination from Cartesian souls, etc., or any "downward causation" from an entity in a higher-level domain which is not itself supervenient upon lower-level entities. Cp. Terence Horgan's restriction to "physically accessible" worlds in "Supervenience and Microphysics," op. cit.; and David Lewis' use of "natural" properties in "New Work for a Theory of Universals," *Australasian Journal of Philosophy* 61 (1983): 343—377.

[23] Jaegwon Kim, "Psychophysical Supervenience," op. cit., p. 55; also his "The Nonreductivist's Troubles with Mental Causation," in John Heil and Alfred Mele, ed., *Mental Causation* (Oxford University Press, 1992), sec ii.

[24] Ernest Lepore and Barry Loewer, "More on Making Mind Matter," *Philosophical Topics* 17 (1989): 175—191, at p. 179, first italics mine, and variables adjusted to match our own.

[25] Stephen Yablo, "Mental Causation," *Philosophical Review* 101 (1992): 245—280, at p. 255, italics mine.

[26] This sentiment is not universally shared. E.g., in his "Weak Supervenience and Materialism," *Philosophy and Phenomenological Research* 48 (1988): 697—709, William Seager defends the weaker relation by arguing that "cross-time" modalities will suffice to capture talk of psychophysical dependency, and that the correct way to evaluate the relevant counterfactuals does not imply a modally strong relation.

[27] Jaegwon Kim, "'Strong' and 'Global' Supervenience Revisited," *Philosophy and Phenomenological Research* 48 (1987): 315—326, esp. pp. 320—321; and his "Supervenience as a Philosophical Concept," *Metaphilosophy* 21 (1990): 1—27, at p. 23. Kim's argument can be taken in a number of ways. For a critical discussion, see John Post, "'Global' Supervenient Determination: Too Permissive?"; and Thomas Grimes, "The Tweedle Dee and The Tweedle Dum of Supervenience," both forthcoming in *Supervenience: New Essays*, eds. Elias Savellos and Umit D. Yalcin (Cambridge University Press, 1994).

[28] Sydney Shoemaker, "Some Varieties of Functionalism," pp. 96—97; and my "Macdonald on Type Reduction *Via* Disjunction," pp. 212—213.

[29] It is clear that Block and Fodor have sufficient conditions in mind. They say "the disjuncts of A are severally sufficient conditions for p_1 and the disjuncts of B are severally sufficient conditions of p_2" ("What Psychological States Are Not," p. 240). Indeed, the very idea of "realization" presupposes sufficiency — an electron which forms *part* of the realization of mentality on some occasion is not "the realization" of that mental state.

[30] I should like to thank Charles Carr, Thomas Grimes, and Jaegwon Kim for their helpful comments on an earlier draft of this paper. The comments of an anonymous referee also helped enormously. Also a word of thanks to John Post and Terence Horgan for making available some forthcoming material on supervenience. Finally, I owe Cynthia Macdonald a debt of gratitude for responding to an earlier paper of mine, which caused me to think about the notions of plasticity discussed here.

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