

# A Liberal Conception of Multiple Realizability

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Abstract: While the concept of multiple realizability is widely used, it is seldom rigorously characterized. This paper defends a liberal conception of multiple realizability as sameness of type through *any* differences in the (lower-level) conditions that give rise to instances of that type. This kind of “sameness through difference” is contrasted with another type of asymmetric dependency relation between properties, multiple *specification*. This liberal conception is then defended from objections, and it is augmented by a concept of relativized multiple realizability. The last section presents a survey of the ontological, explanatory, and methodological consequences of this analysis of multiple realizability.

Socrates: But, Meno, to follow up the image of the swarms, if I were asking you what is the nature of bees, and you said that they are many and of all kinds, what would you answer if I asked you: “Do you mean that they are many and varied and different from one another insofar as they are bees? Or are they no different in that regard, but in some other respect, in their beauty, for example, or their size or in some other such way?” Tell me, what would you answer if thus questioned?

Meno: I would say that they do not differ from one another in being bees.

Socrates: If I went on to say: “Tell me, what is this very thing, Meno, in which they are all the same and do not differ from one another?” Would you be able to tell me?”

Meno: I would. (*Meno*, 72a-c)

One of the oldest philosophical projects is to explain what it is for different individuals to be of the same kind, and to examine the consequences that follow from this. Socrates argued that instances of a given kind do not differ with regard to that kind. Different bees, he seems to have claimed, do not differ with regard to their “bee-ness”. But it seems reasonable to disagree. Drones, workers, and queens are different types of bees, and, for that reason, they seem to differ with respect to their “bee-ness”. It is true that there is something that drones, workers, and queens all have in common (*that* they are bees). Interestingly, this very commonality is also the source of a special kind of variance and difference. *Because* they are all bees, they can differ with respect to their “bee-ness”. But, importantly, not every difference between bees should count as a “bee-difference”. I think that explaining the general principles at work in the Socratic example—the varieties of sameness through difference—will also help us to clarify the modern concept of multiple realizability (MR).

The concept of MR is best known for its applications in the philosophy of mind and psychology. This is natural, as the first MR arguments were presented by Hilary Putnam (1975a, 1975b, 1975c) and Jerry Fodor (1974/1980) in this context. For them, the MR of mental kinds with respect to physical kinds was taken as sufficient for establishing some form of non-reductionism (functionalism in particular), and their arguments have been widely accepted by non-reductionists about the mental. But the concept of MR is not limited to mental kinds—it can similarly be used as a premise in arguments for non-reductionism in a variety of domains. And it is in this general sense that I wish to examine the concept of MR. MR is of particular interest due to its connections with the issues of ontological reduction, explanation, and methodological autonomy in the special sciences.

We should separate three questions concerning MR:

1. What does it mean for a property (kind, type, predicate, etc.) to be multiply realized?
2. Why is MR important?
3. Is some particular property type multiply realized, and, if so, what consequences follow from this?

The last question is largely of an empirical nature, and will not be addressed here. Instead, I am concerned with the first question—what does it even *mean* for a property to be multiply realized? But in order to answer this question properly, and correctly carve out the nature of MR, we must also consider the second question. Our account of the concept of MR will not be successful if it loses what was supposed to be important about MR in the first place.

## Sameness through difference

The basic idea behind MR is: sameness of type through differences in the (lower-level) conditions that give rise to instances of that type. The different “conditions that give rise to instances of that type” are the *multiple realizations*. The classic example of a multiply realized property comes from Putnam (1975b). Pain, it was suggested, is multiply realized because human beings, alligators, and octopi can have sameness of pain through differences in the brain conditions that give rise to these pains. The different brain conditions are the multiple realizations.

Important caveat: In this paper, I will not attempt to offer an account of the realization relation itself. Metaphorically, realization is a more *intimate* relation than its sister relation, supervenience (which is a purely nomic or logical relation). Realized properties are *with* their realizations in a way that supervenient properties need not be with their bases.<sup>1</sup> I do not yet know how to account for realization<sup>2</sup>, and I will treat supervenience and realization as roughly equivalent relations *as far as present purposes are concerned* (as both are varieties of “giving rise to”). I ask that the reader grant me this much liberty, and I couple this request with the assurance that there will be enough controversy even with such a concession! What I intend to give an account of is the *multiplicity* of realizations. Assuming that we have an account of realization at hand, when do we have *multiple* realizations of a single kind? (While not offering a positive account of realization, I will contrast it with what I call *specification*.)

There is wide agreement on certain examples. Water has a single chemical realization—H<sub>2</sub>O. No other chemical composition realizes water. For this reason water *is* H<sub>2</sub>O. Here we see the connection between MR and reduction. The fact that water has

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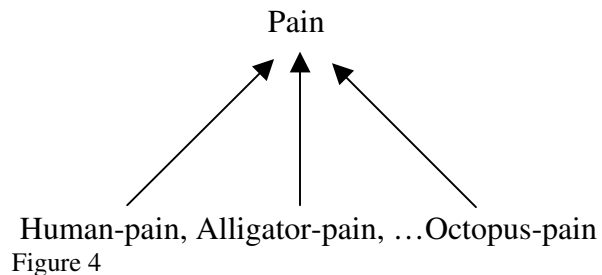
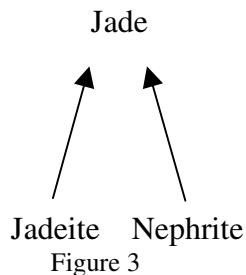
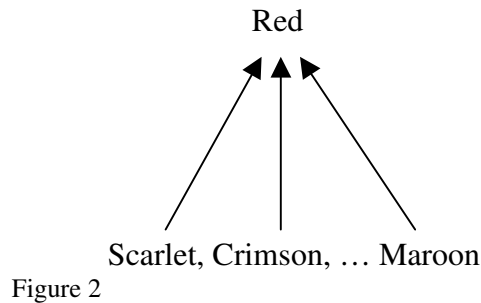
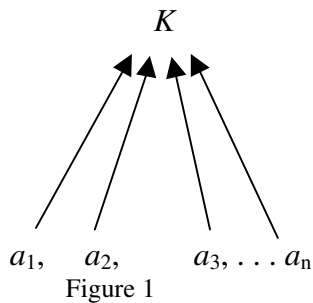
<sup>1</sup> For this reason, as Andrew Melnyk (2003), Chapter 2 argues, realization claims can *explain* supervenience claims.

<sup>2</sup> Honorable recent attempts at such clarification have been offered by Shoemaker (2001), Gillett (2002, 2003) and Melnyk (2003). One problem I have with these attempts is that they either limit realization to functional properties or (in my opinion) mistakenly depend on a causal theory of properties. Less recent, but highly influential, accounts of realization have also been presented by Lycan (1987) and Poland (1994).

only one type of realization allows water to be reduced to that type of realization. Functional kinds, in contrast, are widely acknowledged to be multiply realized. A functional kind is a kind that is individuated by the function it performs. Typically, there are many different structures that can perform the same function. So, a functional kind is multiply realized and cannot be reduced to any one such structure.

### Asymmetric Dependence

Thinking of MR in terms of its component concepts, realization/supervenience<sup>3</sup> and multiplicity, suggests a simple account of MR as *asymmetric dependence* (see Figure 1). Here  $K$  is supposed to be the multiply realized kind, the  $a$ 's are the multiple realizations, and the arrows represent the realization relations. On this model,  $K$  asymmetrically depends on the  $a$ 's—i.e., each  $a_i$  necessitates  $K$ , but  $K$  does not necessitate any particular  $a_i$ . If MR simply is asymmetric dependence of this type, then all properties that can be modeled as such would provide us with examples of MR.



<sup>3</sup> I will simply write of “realizations” in the following occurrences, though I am still open to the possibility of an account of realization in terms of supervenience. Again, I ask the reader to grant me some flexibility in this usage.

Let us consider different properties that can be modeled as such. The color type red asymmetrically depends on the various ways of being red—e.g., scarlet, crimson and maroon (as depicted in Figure 2). If MR simply is asymmetric dependence, then this shows that red has multiple realizations. We do know that red cannot be *reduced* to scarlet, crimson, or maroon. And we do say that these are *different ways* of being of the *same type*—red. These expressions are also familiar when speaking of MR.

Next, consider Jaegwon Kim’s famous example of jade and its alleged multiple realizations (Kim 1993, 319-325)—jadeite and nephrite (depicted in Figure 3). Jade cannot be reduced to either jadeite or nephrite (as neither is a more likely candidate than the other), and each is a different way of being of the type jade (assuming that there is such a type).

Finally, consider the diagram of the mental kind pain (Figure 4). Functionalists and others have argued, at least since Putnam, that members of different biological (or even non-biological) kinds can instantiate the same pain-type while differing in the structures that realize those pains. Again, it could be said that each is a different way of being in pain, and pain does not reduce to any one of these structure-types.

On the crude model of MR as asymmetric dependence, red, jade, and pain bear the same relations to their “realizers”. But, I will argue, there are important distinctions between these three examples that should be reflected in our account of MR.

Scarlet, crimson and red are all color-types, and are individuated according to the dimensions shared by all colors—say, hue, brightness, and saturation.<sup>4</sup> Call these dimensions along which a property type can be qualified, *with respect to the type that it*

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<sup>4</sup> The dimensions by which colors are individuated could be debated. Alternative individuating conditions have been proposed in the philosophical literature on colors. All that is important for present purposes is that there are some such dimensions/conditions, and the debate over what the right conditions are assumes that some such dimensions exist independent of the classifying mind.

is, the *determination dimensions* of that property type.<sup>5</sup> As crimson and scarlet differ from each other along some of the determination dimensions shared by all colors, they are different colors (i.e., different determinates of the property color). Specifically, they are different reds or different ways of being red. Scarlet and crimson are both of the type red, but they also differ with respect to their redness. This parallels our earlier statement about bees—drones and workers are both types of bees, but they also differ with respect to their “bee-ness”.

When philosophers allege that pain is multiply realizable, they mean (or they *should* mean) something quite different. Figure 4 seems to show that human-, alligator-, and octopus-pain are different ways of being in pain, just as scarlet, crimson, and maroon are different ways of being red. But the cases are not parallel. As drawn, Figure 4 is ambiguous. It might be thought that, just as scarlet and crimson differ along some of the dimensions by which colors are individuated, alligator-pain and human-pain differ along some of the dimensions by which pains are individuated. Let us assume that pain is a phenomenological kind. (Nothing hinges on this assumption, but it makes exposition easier.) Then, just as scarlet and crimson are different shades of red, alligator-pain and human-pain might be different intensities of pain (or else they might differ in some other pain-relevant feature). That is, alligator-pain and human-pain might differ with respect to their “pain-ness”. But this is not at all what proponents of the MR of pain have in mind. Rather, they intend to claim that alligators and humans can have sameness of pain, through differences in the conditions that give rise to their pains. (Notice that I am not claiming that pain actually is multiply realized; rather, I am simply clarifying what would be required for pain to be multiply realized.)

This is a much stronger sense of “sameness through difference” than that which holds for the different shades of colors. We should introduce terminology to capture this

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<sup>5</sup> These individuating dimensions for properties are thoroughly discussed in my “The Determinable-Determinate Relation” (forthcoming).

distinction. Let us say that scarlet, crimson, and maroon are three of the *multiple specifications* (or *determinates*) of red. The multiple specifications of some kind *X* are the specific ways of being *X* that differ with respect to their *X*-ness. E.g., scarlet, crimson, and maroon are three of the multiple specifications of red because they are specific ways of being red that differ with respect to their redness. Similarly, jadeite and nephrite might be multiple specifications of jade (but only if jade is also a mineralogical kind<sup>6</sup>). Multiple specification is a type of asymmetric dependence, but MR is an importantly different type of asymmetric dependence.

The contrast with multiple specification jump-starts our analysis of MR. I suggest the following extremely simple conditions for MR that capture our strengthened idea of “sameness through difference”:

A property-type *X* is multiply realizable if, and only if, there are possible instances of property-type *X* that:

- i) exactly resemble one another with regard to their *X*-ness (i.e., they possess the same determination dimension values for the *X*-kind), though
- ii) the realization bases for these instances do not *exactly* resemble each other at *some* level of abstraction (i.e., their realization bases differ with respect to *some* set of determination dimension values).<sup>7</sup>

We see what would need to be the case in order for pain to be a multiply realizable kind according to this analysis. Pain is multiply realizable if, and only if, it is possible to have exact resemblance of pain through differences in the lower-level conditions in which those pains are realized.

This analysis has two necessary clauses for MR, which I claim to be jointly sufficient for MR. Each clause is novel and bold. Clause i) provides a *restriction* on MR, disqualifying mere cases of multiple specification (i.e., determination) as cases of

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<sup>6</sup> Because jadeite and nephrite are distinct mineralogical kinds and are varieties of jade, Jaegwon Kim (1993) denies that jade itself is a mineralogical kind. We return to this example later in this paper.

<sup>7</sup> This analysis is of the modal notion multiple realizability. An analysis of the non-modal notion of a property being multiply realized is generated by simply eliminating the occurrence of ‘possible’ in the present analysis. The present analysis of MR can also be seen as schematic for a variety of modal notions of MR, corresponding to the various strengths with which the occurrence of ‘possible’ could be interpreted as possessing.

multiple realization. This is a significant clause—one that I have defended elsewhere against proposals by Shoemaker and Yablo, for example, that do not mark this distinction.<sup>8</sup> I have already made some defense of clause i) in the present paper as well. But most of what follows will be dedicated to defending clause ii). Many will probably be drawn to the bold *liberality* of clause ii). Though ruling out cases of properties related as determinable to determinate, the present analysis otherwise quite readily countenances MR. This liberality will be defended in the next section. (Note to reader: If you do not accept both clauses as necessary (and jointly sufficient) for MR, perhaps at least one of them will be so accepted. And this would still be some accomplishment.)

It should be emphasized that multiple specification and MR are not mutually exclusive. The very same property or kind can admit of both multiple specifications and multiple realizations. Indeed, it is very plausible to think that pain admits of both kinds of qualification. Sharp pains and dull pains are two specifications of pain (since they differ in their “pain-ness”), so pain is multiply specified. And each instance of pain is of some maximally specific type (just as each instance of color is some very particular shade). But if instances of the same maximally specific type of pain differ at some lower-level of abstraction, then it follows from our analysis that this maximally specific pain type, *and pain simpliciter*, is multiply realized.

### **Responses to Objections**

Objection 1. But this analysis cheapens MR. Almost every property is multiply realized in this sense!

If all that is required for MR is *some* realization difference across members of the same (non-determinable) type, no matter how fine or low-level this difference is, then multiply realized properties are ubiquitous. This might seem like an objection to the present conception of MR. Surely MR is somehow special, and something is lost if so many properties are multiply realizable. Worse yet, even standard examples of properties

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<sup>8</sup> Funkhouser (forthcoming). This proposal contrasts with Shoemaker (2001) and Yablo (1992).



that are *not* multiply realizable turn out to be multiply realized on this conception. As we have already agreed, water is a paradigmatic example of a non-multiply-realized kind—its only realization is H<sub>2</sub>O. But samples of the very same type of water might nevertheless differ at some extreme microphysical level. Such a difference would be sufficient to establish that even water is multiply realized according to this analysis. Is this a refutation, a *reductio ad absurdum*, of the present conception? No.

This liberality is acceptable once we realize that there is also a concept of relativized MR. Samples of water can be studied using the classifications (i.e., determination dimensions) of various sciences that operate at different “levels”. One system of classification looks at samples of water as collections of molecules with a certain structure. Molecular types are individuated by the types of atoms that compose them, and their chemical bonds. The varieties of atoms and the ways in which they can bond then provide the determination dimensions for this system of classification. As all samples of water map onto only one set of molecular determination dimension values—namely, a single oxygen atom bonding with two hydrogen atoms—water has only one molecular realization. As molecules are within the domain of chemistry, and water perfectly correlates with only one type of molecular realization, water is then correctly classified as chemical kind.

But samples of water can also be studied using the classifications of microphysics. Water is multiply realized *relative to microphysics* if, and only if, there is sameness of “water-ness” across microphysical differences. A microphysical difference is a difference in the determination dimension values of microphysics—e.g., a difference at the level of electrons, protons, etc., (or lower) and their properties. Naturally, we would expect that almost any two samples of water would differ at this level. Establishing such a difference is a necessary, but not yet sufficient, condition for MR (only clause ii) of our conditions has been met). For water to be multiply realizable, it must also be the case that these microphysical differences can occur without making a “water difference” (this

is clause i) of our conditions). What are the determination dimensions corresponding to “water-ness”? I am not sure.<sup>9</sup> But so long as they involve only higher-level properties such as temperature, impurities, etc., that are blind to microphysical detail, then water is multiply realized relative to microphysics. If this is the case water meets our conditions for MR *simpliciter* as well. Those who point out that water is not multiply realized, with H<sub>2</sub>O as its only realization, are still onto something correct. Water is not multiply realized *relative to that chemical level of abstraction*. Further, the fact that water is realized in these chemical states of affairs, while not being *multiply* realized in them, is what *makes* water a chemical kind. This was our first application of the concept of MR to reduction. If water is multiply realized in the microphysical, then this fact also establishes that water is *not* a microphysical kind. Our concept of relativized MR *explains* these facts.

The relative concept of MR should be understood as follows:

A property-type *X* is multiply realizable relative to science *Y* if, and only if, there are possible instances of property-type *X* that:

- i) exactly resemble one another with regard to their *X*-ness (i.e., they possess the same determination dimension values for the *X*-kind), though
- ii) their *Y*-realization bases do not *exactly* resemble each other with regard to their *Y*-ness (i.e., their *Y*-realization bases differ with respect to some determination value for the *Y*-kind) .

We should also note that the present conception of MR is still more restrictive than many others to the extent that it distinguishes between multiple specifications and multiple realizations. Stephen Yablo and Jaegwon Kim, for example, have sometimes mistaken multiple realizations for multiple specifications (and *vice versa*), whereas we have analyzed MR so as to avoid this possibility. Yablo has written:

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<sup>9</sup> I thank an anonymous referee for drawing my attention to the difficulties in providing determination dimensions for this example. It is helpful to keep in mind the following rule: The more determination dimensions we include for a kind, the more cases we count as multiple specifications (as opposed to multiple realizations) of that kind. For water, as with many other kinds, relational properties—e.g., its location and neighbors—are not relevant to its nature (i.e., determination dimensions or “water-ness”).

...mental/physical relations are a species of determinable/determinate relations. “Can you really be saying that mental properties stand to their physical realizations in the relation that rectangularity bears to squareness, or that colors bear to their shades?” Yes. At least that is my conjecture... (Yablo 1992, 256)

But the relation of shades to their colors, as we have already argued, is one of specification, not realization. And Kim writes:

The important moral of MR we need to keep in mind is this: *if psychological properties are multiply realized, so is psychology itself*. If physical realizations of psychological properties are a “wildly heterogeneous” and “unsystematic” lot, psychological theory itself must be realized by an equally heterogeneous and unsystematic lot of physical theories. (Kim 1993, 328-329)

But, a case of multiple psychologies surely is *not* a case of MR (since there is not sameness of psychological-type across subjects)!

Objection 2: Ruth Millikan and Lawrence Shapiro’s alternative—multiple realizations are different *ways* of performing the same function.

Shapiro (2000, 2004) argues that only a proper subset of functional properties are multiply realizable. In contrast with the *a priori* nature of the early functionalists’ arguments for MR, Shapiro claims that MR requires that there be multiple *ways* of performing the relevant function. Since, as he uses ‘way’, not every difference in a realization counts as a different way of performing that function, this construal obviously opposes the present conception as well. Shapiro (2000) can be seen as a development of Millikan’s(1999) passing comments:

Sometimes different mechanisms that accomplish the same operate [sic] in accordance with different principles; other times they represent merely different embodiments of the same principles. Or we might say, sometimes looking more closely at the mechanism helps to explain *how* it works; sometimes it reveals only what stuff it is made of. It is only the former kind of difference that makes interesting “multiple realizability”. (Millikan 1999, 61-62)

As Shapiro (2000) offers a more developed presentation of this line of thought, I will limit my focus to that paper.

Shapiro emphasizes that it requires empirical work to determine if a given function can be performed in multiple ways. Shapiro explains his proposal as follows:

Some of the properties of the realizers of multiply realizable kinds are relevant to the purpose, activity, or capacity that define the kind and some are not. I asked in the introduction whether two corkscrews, alike in constitution and mechanism but distinct in color, count as alternative realizations of the kind *corkscrew*. I claim that they do not because the only property by which they differ—color—is not a property that contributes to their capacity to remove corks. To say that a kind is multiply realizable is to say that there are *different* ways to bring about the function that defines the kind. (Shapiro 2000, 643-644)

Shapiro separates those properties that are relevant to the function of a kind from all the other realization properties. Only differences in the former properties amount to differences of realization.

This division of properties corresponds to one that we have already emphasized. Those properties that are relevant to the function of a kind simply are those at that level of abstraction. A functional kind is an abstraction that isolates certain functional properties. So, functional kinds, *qua* functional kinds, differ only with regard to the performance of these functions. Features that are not relevant to the performance of that function are not manners in which instances of a functional kind can differ (at least *qua* that functional kind). For example, corkscrews can differ (*qua* corkscrew) with respect to their mechanism for removing corks, but not with respect to their color or material constitution.<sup>10</sup> Compare: colors can differ with respect to hue, brightness, or saturation, but not with respect to chemical makeup, etc.

Mapping Shapiro's division of relevant and non-relevant realizer properties onto our division between multiple specifications and multiple realizations of a type helps to reveal what is mistaken about his restrictions on MR. Shapiro's different ways of fulfilling a function are different specifications along the same level of abstraction

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<sup>10</sup> I do not want to suggest that there are different realizations of corkscrews in virtue of the different colors of corkscrews. As our analysis of MR informs us, the colors must be part of the realization bases of the corkscrews in order for it to be even possible for the different colors of corkscrews to ground the MR of corkscrews. I doubt that the proper account of realization will have this outcome. (Compare this point with Gillett (2003), pp. 598-599.) However, if the color and corkscrew *share* a realization base, then (with standard physicalist assumptions in place) difference in color will guarantee corkscrew MR. But this MR would be grounded in the shared realization bases, not the differences in color.

(determinable). E.g., the different mechanisms of corkscrews are different determinates along the abstraction ‘cork-removing techniques.’ Whereas Shapiro judges the “waiter’s” and “winged” varieties to be multiple realizations of the corkscrew type, our theory judges them to be multiple specifications of the corkscrew type.<sup>11</sup>

Again, the basic idea of MR is that there is sameness of *X*-type through differences in *Y*-type, though *X*-type properties are realized in the *Y*-type properties. The mental is multiply realized in the physical if there is sameness of mental type through differences in the physical types, even though the mental type is realized in those physical types. Now let us apply this to the corkscrew example. Corkscrew MR consists in sameness of corkscrew type through difference in some other *Y*-type, though the corkscrew type is realized in the *Y*-type properties. Shapiro offers the different mechanisms—“waiter’s” and “winged”—as different *Y*-types that serve as multiple realizations. But note that a difference in corkscrew mechanism is a “corkscrew difference.” Indeed, this seems to be Shapiro’s whole point. But, importantly, *multiple realizations of an X-type do not make a X-type difference!* Multiple realizations of a mental kind like pain, if they exist, do not differ in their “pain-ness”. In contrast, different mechanisms of corkscrews do differ in their “corkscrew-ness”.

Objection 3: Real heterogeneity is required, not just variability.

Multiply realized properties are co-extensive with disjunctive properties (i.e., the disjunction of their multiple realizations). But advocates of MR typically have not taken co-extensiveness with just *any* such disjunction as sufficient for MR. Rather, multiply realized properties are said to be “wildly disjunctive” or “heterogeneous”. (Kim 1993,

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<sup>11</sup> Properties that are multiply specified, determinables such as red and corkscrew, can still be cited in autonomous laws and generalizations that abstract away from their specifications. E.g., there can be laws about red things as such (as well as laws about crimson things as such). Even if there are laws about red things as such, it does not follow that scarlet and crimson are multiple realizations of red (as opposed to specifications). Red still has the same determination dimensions as before, it is just that the particular determination dimension values are irrelevant as far as the supposed law is concerned. I thank an anonymous referee for drawing this possibility to my attention.

321) Functional properties are relevant here, because the same functional role can typically be occupied by extremely diverse physical mechanisms. E.g., the same computer program can be implemented in various hardware. This type of “structural insensitivity”, many will claim, is the hallmark of MR. However some properties that exactly resemble at one level of abstraction have variable realization bases (hence meeting our standards for MR), but lack this required insensitivity to structure. For example, a property might have a very limited range of realizations, or the realizations might structurally resemble one another much more closely than do the realizations of a functional kind. Such a property should not count as multiply realized, this objector argues, but turns out as such according to our analysis.

I have two responses to this objection. First, judgments of similarity are always relative to some level of abstraction. Functional properties are distinctive in that they are multiply realized even at very high levels of abstraction. For example, various medium-sized contraptions can occupy the role of a carburetor.<sup>12</sup> This heterogeneity at our everyday, medium-sized level of abstraction makes being a carburetor an obvious multiply realized kind. But note that other kinds that do not have many, or diverse, medium-sized realizations, can still have (and likely do have) diverse, “wildly disjunctive”, “heterogeneous” realizations at a much lower level of abstraction. So, they still meet this more restrictive standard for MR relative to at least one level of abstraction. We speak of such kinds as being multiply realized in the microphysical.

But, second, the “wildness” and heterogeneity requirement itself, regardless of the level of abstraction to which it is applied, introduces a vagueness that threatens the connection MR is supposed to bear to ontological reduction. Our analysis provides sharp conditions for MR: *any* difference in realizations (at some level of abstraction) through

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<sup>12</sup> Significantly, according to the present view carburetors are multiply realized *not* because there are different varieties of carburetors—e.g., slide and barrel carburetors. These are specifications of the carburetor type, analogous to winged and waiter’s corkscrews. Instead carburetors are multiply realized because carburetors *of a determinate type* can be made from various materials, in different arrangements, etc. Again, I thank an anonymous referee for pointing this consequence out to me.

sameness at the higher-level of abstraction is sufficient for MR. Even a higher-level property that is co-extensive with the disjunction of two realization bases turns out to be multiply realized on our view. Critics may point out that such sharp conditions cannot possibly be correct because MR is a vague concept, or at least admits of degree. In response, there is still a clear sense in which MR admits of degree on the present analysis. Just as we can speak of properties being “more disjunctive” in virtue of having more disjuncts, so too we can speak of greater MR in virtue of more types of realization bases. And the dissimilarities of the realization bases (again, at some lower level of abstraction) provide another dimension for determining the degree of MR.

But why should a higher-level property that has only two, perhaps closely resembling, realizations count as multiply realized? One answer is that MR has traditionally been used as a tool for refuting simple one-to-one type-identities in the philosophy of mind. If pain is co-extensive with two neurobiological types, then pain clearly cannot be identified with merely one of these types. (Here I refrain from discussing the legitimacy of identifying pain, or any other apparently homogeneous kind, with disjunctive kinds.) Compare this with Kim’s example of jade, which is co-extensive with two mineral kinds (jadeite and nephrite), so not reducible to either in isolation. It is possible that jade itself is a kind, but not a *mineral* kind. For, properties that are co-extensive with disjunctions of *Y*-kinds are not necessarily *Y*-kinds themselves. This may be because there are no such disjunctive kinds at all (e.g., for reasons Armstrong (1978, Chapter 14) provides) or there are such kinds but they are not *Y*-kinds because they do not figure in any *Y*-laws (or perhaps any other laws, for that matter, due to projectibility worries (Kim 1993 and Fodor 1974/1980)). Just as jade (epistemically) might not be a mineral kind and its two mineral varieties—jadeite and nephrite—(epistemically) might be two of its (mineral) realizations, pain (epistemically) might not be a neurobiological kind in virtue of having multiple (if only two) neurobiological realizations.

It is widely accepted that this liberal conception of MR is sufficient to deny type-type identities on the Nagelian, positivistic conception of reduction. However, it might be argued that more sophisticated versions of reduction have been developed in the last few decades (e.g., Hooker 1981, Churchland 1986, and Bickle 1997) that are not refuted by this liberal conception of MR. In response to these more sophisticated versions of reduction, some may argue that a more sophisticated concept of MR is also required in order to for MR to maintain its conceptual connection to issues of reduction. I do not think this is so. Even minimal disjunctivity, as in the case of jade, forces theoretical decisions corresponding to our specification/realization distinction:

a) The disjunctions might be multiple specifications of the broader kind. For example, jade, jadeite and nephrite might each be accepted as legitimate kinds, with jadeite and nephrite two of the specifications of jade. This means that jade, jadeite and nephrite all fall under a common species or determinable, and differ with respect to that same species or determinable. Compare: red, scarlet and crimson all fall under the determinable color, and differ with respect to their color. This is a *retention with specification*.

In order to earn its keep as a mineral kind, however, it is plausible to require that there be generalizations that essentially refer to the broader kind. E.g., there must be true generalizations about jade “as such”. And, as is required for all cases of specification, jade, jadeite, and nephrite would have to share the same determination dimensions (individuating conditions) and differ only in the ranges of values they correspond to within these dimensions.

b) The purported kind in question might simply be *eliminated*. For example, we might discover that whereas we once thought there is this one kind jade, there are actually two resembling kinds, jadeite and nephrite (neither one of which is jade, however). In this case, we replace our jade-talk and jade-generalizations with



more fine-grained jadeite and nephrite talk and generalizations. (Why? Because there are no generalizations about jade “as such”.)

c) Alternatively, the concept of a particular kind might be revised, and that kind then reduced to one of its realization-kinds. For example, suppose jadeite and nephrite each meets many of the criteria for jade, but neither does so perfectly. Suppose, however, that jadeite does a better job of meeting these criteria.

(Alternatively, it might be that jadeite is simply more prevalent than nephrite in the population space.) Our concept of jade might be revised, and we might conclude that jadeite *is* jade. This is a *revisionary reduction*. The vagueness in our concepts, the acceptance of “near-fits”, and the distribution of samples allow for vagueness about reduction. (Still, it is not a vague matter whether MR—a relation between properties—ever occurs.)

d) Finally, the kind in question might be retained, though neither reducing to any of its realization-kinds nor being specified by them. In this case, the kind in question would operate at a “higher”, but still legitimate, level of abstraction, with its own determination dimensions. This status would be vindicated by laws, causal explanations, real similarities, etc. that make essential reference to this kind. This is *ontological non-reductionism*. For example, perhaps jade is not a mineral kind (so it is not reduced to jadeite or nephrite, nor does it share their determination dimensions), but it is still a kind used in scientific laws, causal explanations, real similarity judgments, etc.<sup>13</sup> This differs from option a), in that jade, jadeite and nephrite do not all fall under a common species or determinable. In this case, jadeite and nephrite are the multiple realizations of jade.

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<sup>13</sup> Ontological non-reductionism is compatible with an *explanatory reduction*, whereby the features of the higher-level kind are *explained* by those of their realization-kinds.

Clearly, the “more” multiply realized a kind is, the less likely any kind of ontological reduction becomes. Then, elimination and ontological non-reductionism become the only live options.

Objection 4: MR is not possible for any kind.

On my view, MR is rampant. At the other extreme, some—such as David Armstrong (1997), John Heil (1999), and Heil and C.B. Martin (1999)—deny MR altogether by judging a realizer difference to be, *ipso facto*, a higher-level property difference.<sup>14</sup> To claim MR for a property type is to claim that *the very same* (non-determinable) property type can be realized in diverse lower-level mechanisms. But if a difference in lower-level mechanism is, *ipso facto*, a higher-level difference, then there cannot be MR. Claims of MR would then have to be paraphrased away. On this view, to say that psychological properties are multiply realizable is *really* to say either that there are more psychological properties than one might pre-theoretically think or there are none. Specifically, there is a distinct psychological property type corresponding to each type of realization base (e.g., not just pain, but human-pain, alligator-pain, and octopus-pain). Or, perhaps, such higher-level properties should be eliminated or denigrated to a “second-class” status.

Though they do not explicitly put the point this way, these objectors seem to see a contradiction in the very idea of MR. Again, the fundamental idea behind MR is sameness at a higher-level through lower-level difference. But if higher-level properties arise from *and are composed of* these lower-level properties, then there is a higher-level difference whenever there is any lower-level difference.

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<sup>14</sup> This also seems to be a consequence of Stephen Yablo’s view that a higher-level property is related to its realizer properties as determinable to determinates (although he would not claim to deny MR). Just as scarlet and crimson are different ways (specifications) of being red, Yablo argues that these different realizers are different ways of having the higher-level property. See Yablo (1992), pp. 253-257 in particular. For my response, see Funkhouser (forthcoming).

Of course, MR would be impossible were higher-level properties composed of the lower-level properties that realize them in the same way that an animal body is composed of its cells. But I deny the comparison. MR is possible precisely because the compositional rules that hold for concreta do not hold for properties (abstracta).<sup>15</sup> An example should make this plausible. Objects have centers of gravity as properties. Centers of gravity are realized in, but are not composed of, the mass and spatial properties of an object.

For these reasons, MR is at least possible. This is fortunate for those of us who i) think that *X*-causation (e.g., mental causation) requires *X* properties or kinds, and ii) desire to vindicate mental causation (and many other varieties of causation invoking multiply realized properties or kinds). I presume that there are many of “us”.

### **The Importance of MR**

Recall how we separated three questions concerning MR. We should now turn to the second question. We cannot be confident that we have a correct analysis of MR unless that analysis shows how the concept of MR can do some of the theoretical work that it is supposed to perform. Here is a partial list of the consequences of MR that some have alleged, along with the verdicts the present analysis yields with regard to them :

#### *Ontological*

1. MR establishes type-level non-reductionism—Putnam and Fodor on non-reductionism about kinds (and laws).

To put it briefly, type identical events do not, of course, have *all* their properties in common, and type distinct events must nevertheless be identical in *some* of their properties. The empirical confirmation of token physicalism does not depend on showing that the neurological counterparts of type identical psychological events are themselves type identical. What needs to be shown is just that they are identical in respect of those properties which determine what kind of *psychological* event a given event is. (Fodor 1974/1980, 126)

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<sup>15</sup> This point obviously imposes some constraint on the candidate accounts of realization that are open to one accepting the present position on MR.

Here we see Fodor claiming the following: neurological differences are not necessarily psychological differences. The last sentence of this quotation foreshadows our distinction between specification and realization. Different realizations of a psychological type are not identical *simpliciter* (naturally), but “they are identical in respect of those properties which determine what kind of *psychological* event a given event is.” The “properties” that determine the kind of psychological event at hand are what we have called the determination dimensions for that psychological kind—Fodor’s italics correctly suggest that all other properties should be abstracted (subtracted) away. Contrast Fodor’s discussion of different neurological types that realize the same psychological type with our discussion of red and its various shades. Crimson and scarlet are not multiple realizations of red because, to paraphrase Fodor, they are not identical in respect of those properties which determine what *color* property they are. So, the critical question for MR of an *X*-type is captured in our analysis of MR: Do the supervenience base differences mark a difference in *X*-ness?

It should be obvious that the present account of MR supports Putnam’s insight that MR is the downfall of type-identity theories. If pain is multiply realized with respect to, say, chemical types, then according to our analysis there is more than one chemical type that can serve as the realization base for a maximally specific type of pain. As no particular chemical realization type is necessary for that type of pain, it is not possible to reduce that pain type to any particular chemical realization type.

## 2. MR is nevertheless consistent with *token* reductionism.

Whether the present account of MR allows for a token reductionism is a more complicated matter. First, clarification is needed concerning the ontological status of the tokens in question. Are they events, states of affairs, tropes, or of some other ontological kind? Events are customarily taken to be the relevant tokens (e.g., in the Fodor quotation above), and MR is customarily taken to be compatible with a token identity holding for

an *X*-event and a *Y*-event, where the *Y*-kind is one of the (multiple) realization kinds of the *X*-kind. For example, it is common for type non-reductionists to hold that, though pain (the *X*-kind) is not type identical to neurological type *N* (the *Y*-kind), a pain-event can still be identical to an *N*-event.

Whether such an identity is possible depends on how events are understood. The Davidsonian tradition, which sees events as unstructured, concrete particulars, is conducive to this result. It should be of no surprise, then, that Donald Davidson's anomalous monism is the paradigm of a type non-reductionist theory, coupled with a token reductionism. The possibility of token reductionism is put in serious doubt, however, by alternative conceptions of events according to which they possess an essential/accidental property structure. It is then plausible to hold that the psychological and neurological events, as in our example, would differ in their essential properties and therefore not even be token identical. This worry is even more obvious when the relevant tokens are thought to be states of affairs or tropes. Indeed, elsewhere I have argued against identifying tropes of a multiply realized kind with tropes of their realization kinds.<sup>16</sup>

### *Explanatory*

3. MR properties are needed to provide some singular explanations—e.g., Putnam's peg-and-the-board story.

Suppose we have a very simple physical system—a board in which there are two holes, a circle one inch in diameter and a square one inch high, and a cubical peg one-sixteenth of an inch less than one inch high. We have the following very simple fact to explain: *the peg passes through the square hole, and it does not pass through the round hole. . .*

Now, one can say that in this explanation [one citing geometrical properties] certain *relevant structural features of the situation* are brought out. The geometrical facts are brought out. It is *relevant* that a square one inch high is bigger than a circle one inch around . . . And nothing else is relevant. The same explanation will go in any world (whatever the microstructure) in which

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<sup>16</sup> Funkhouser (forthcoming).

those *higher level structural features* are present. In that sense *this explanation is autonomous*. (Putnam 1975c, 295-296, italics in original)

The present account of MR stresses that realizer-level differences are not differences at the level of the multiply realized kind. Those who do not distinguish between specification and realization fail to capture this fact. Putnam is pointing out that singular explanations should meet the standards of relevance set by the *explanandum*. (We can think of relevance roughly as necessary and sufficient conditions in the circumstances.) The *relevant* properties in this sense often will be invariant through micro-structural changes across worlds (e.g., “The same explanation will go in any world (whatever the microstructure) in which those *higher level structural features* are present.”). Invariance of a type through changes in that type’s realization base is the mark of MR on our analysis.

#### 4. MR is still consistent with micro-explanations of macro-phenomena.

Our conception of MR is consistent with another type of reductionistic agenda, however. Though a microstructural singular explanation of some event (i.e., Putnam’s peg-and-the-board story) might not be appropriate (or there might not even be such a low-level *explanation*), the supervenient higher-level explanation might itself be (synchronically) explainable in terms of its micro-structural properties. Discounting any strong type of emergence, this is certainly the case.

Here we can distinguish two different types of scientific projects: intra-theoretic work that operates autonomously and inter-theoretic work that looks for connections between sciences (perhaps investigating supervenience relations in particular). These two types are not intended to exhaust the methodological options, or even be mutually exclusive. Rather, they are two types of scientific temperament that are welcomed by the current picture of MR. To the extent that multiply realized kinds are blind to realization differences, autonomous intra-theoretic work is possible. But, to the extent that

realization relations hold between realizers and the kinds they give rise to, the inter-theoretic project is viable as well.

### *Methodological*

5. When the types of a science are multiply realized, that science is methodologically autonomous (at least as far as generalizations invoking those multiply realized types are concerned).

Roughly speaking, a science *X* is autonomous with respect to some other science *Y* if fruitful development of *X*-theories can proceed in ignorance of *Y*-theories and *Y*-classifications. For example, if psychology is autonomous with respect to neuroscience, then fruitful development of psychological theories can proceed in ignorance of neuroscientific theories and classifications.

This methodological claim is much stronger and more controversial than the previous claims. Our account of MR suggests that, to the extent that realization details are irrelevant to individuating the multiply realized kind, one can have complete understanding of the multiply realized kind while remaining ignorant of realization details. In this sense, it is possible *in principle* for theorizing about a multiply realized kind to be comprehensive and correct, with respect to the theory it appears in, even in the face of ignorance of the sciences of its realizations. But, this does not mean that attention to realization details will not aid in studying the multiply realized kinds *in practice*. And, of course, our methodological principles should be governed by what works in practice!

It is an empirical question whether investigation at the realization-level can prompt us to discover higher-level generalizations and features that abstract away from this very realization-detail. Indeed, our account of MR even seems compatible with the reductionistic *methodological* strategy recommended by Churchland (1986), whereby sciences typically co-evolve. (Churchland 1986, 362-376) On her picture, the higher-level kinds are “susceptible to correction and reconceptualization at the behest of the cohort theory.” (373) Our account of MR is compatible with accepting this “level

jumping” as a methodological strategy for uncovering the proper higher-level kinds. However, we would reject her more ontological claim that the discovery of realizer-differences predicts a “fragmentation” of the multiply-realized kind. (365) Emphatically, we still insist that there can be higher level sameness through lower-level difference. Churchland is correct, however, that reduction is often an epistemic possibility, and this provides reason enough for inter-level investigation. Furthermore, there might be specifications of a higher-level kind (in our technical sense) that cannot be discovered (as a matter of practical fact) but by descending to lower-level realization detail.

6. Contrary to the claim in 5., there cannot be an empirical science ranging over multiply realized (functional) kinds.

It has been argued by both metaphysicians (e.g., Kim (1993)) and philosophers of science (e.g., Millikan (1999) and Boyd (1999)) that multiply realized kinds, insofar as they are functional kinds, cannot serve as the predicates of an empirical science. Millikan states her conclusion as follows:

Indeed, I will argue, the idea that there could be an univocal empirical science that ranged over multiple realizations of a functional property is quite problematic. For example, if psychological predicates name multiply realized functionally defined properties, then there can be no single science that deals with all items having these properties, human psychology, ape psychology, Martian psychology and robot psychology are necessarily different sciences. (Millikan 1999, 47)

There is a shared rationale supporting the conclusion of Kim, Millikan, and Boyd. Basically, the idea is that the multiple realizations of a functional kind would be so diverse that we should not expect them to fall under any common regularities, but for those given in their functional specification. (Kim 1993, 324-327; Millikan 1999, 50, 54-55, and 58-60; Boyd 1999, 69-72)

This position obviously counters the optimism of those trumpeting the autonomy of psychology. But, how does the present account of MR affect this debate? First, it should be noted that Millikan and Boyd (and perhaps even Kim) are directing their arguments



against multiply realized *functional* kinds. But according to our account of MR even non-functional kinds can be multiply realized. In one of our examples it was shown that even if pain is a non-functional (phenomenological) kind, it can be multiply realized on our account. And at least some non-functional properties, like having a center of gravity, come out as multiply realized. The insight is that MR goes hand-in-hand with operating at a different “level of abstraction”. So, even if Millikan and Boyd are correct that there cannot be an empirical science ranging over functional predicates, they have not shown that there cannot be an empirical science ranging over non-functional multiply realized kinds.

I do not think that accepting the present account of MR commits one either way in this debate. However, I feel obliged to state my sympathy for the view that there can be an empirical science of functional kinds. It seems clear that there are empirical sciences ranging over non-functional multiply realized kinds. Why shouldn't we expect the same for multiply realized functional kinds? We can object to Kim, Millikan, and Boyd by pointing out that the reasoning they use against an empirical science of functional kinds equally holds against sciences ranging over non-functional multiply realized kinds. But surely there are sciences of the latter type! For example, there is a science ranging over centers of gravity. But we could apply their same rationale against even this possibility: Just as radically different creatures can share psychological properties in virtue of radically different realization bases, radically different objects can share center of gravity properties in virtue of radically different realization bases. Suppose that we should not expect there to be any interesting (i.e., *a posteriori*) generalizations that hold across radically different realizations of the same psychological (functional) kind. Then similarly, we should not expect there to be any interesting (i.e., *a posteriori*) generalizations that hold across radically different realizations of the same center of

gravity properties.<sup>17</sup> This *form* of argument (even apart from the specific example involving centers of gravity as multiply realized, which you may disagree with) seems wholly indifferent to whether the multiply realized kind is functional or not.

The discussion of this section shows that the connections between MR and “reductionism” are quite complicated. As should be obvious by now, there is not one sense of “reductionism”. Our list of 6 ontological, explanatory, and methodological conclusions that one can reach regarding multiply realized kinds distinguishes at least 6 types of reductionism/non-reductionism. And this list is not supposed to be exhaustive.

The goal here has been to clarify the very concept of MR. While the connections between MR and the varieties of reduction can, and should, be developed more significantly, the present conception of MR is both plausible and captures what we typically want from the relation. It is of particular importance that we separate the concepts of multiple specifications of a kind and multiple realizations of a kind. Multiple realizations are not different *ways* of being a kind, as in Shapiro’s presentation of MR. Rather, different realizations differ while also being the *very same way*. In a very strong sense, MR is sameness through difference.<sup>18</sup>

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<sup>17</sup> I use an example involving centers of gravity because it is a property that Millikan (1999) rhetorically dismisses as obviously *not* a multiply realizable functional property (p. 61). She may be correct that it is not a multiply realizable *functional* property, but, as I have argued, it still might be a multiply realized property!

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