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Niall J. Paterson

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Dispositions and Token Identity

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What is the relationship between dispositions and their categorical bases? Those who answer "identity" bear the burden of accounting for multiple realisation. According to orthodoxy, multiple realisability is a distinctively type-type phenomenon, and hence is unproblematic for token-token identifications. In this paper *plurally realised* dispositions are presented. It is argued that plural realisation is as problematic for the token-token identity theorist as standard type-type multiple realisation is for the type-type identity theorist. As an upshot, retreats to token identity in response to the problem of multiple realisability are shown to be dialectically inert, and alternative responses are corroborated.

1 The Identity Theory

What is the relationship between dispositions and categorical properties, for instance fragility and molecular structure, or belief and states of the brain? According to

> The Identity Theory. Each dispositional property is identical to some categorical property.[1]

What are dispositions, and the categorical properties they are to be identified with? Standardly, both categories are ostensively defined. Fragility, flammability, mass, charge, and the like—*these* are the dispositions. Categorical prop-

1 I have restricted the discussion to dispositional properties. The arguments that follow may, though, have force for those mental properties that are naturally construed in dispositional terms (i.e., belief and desire). They will not have force with respect to the identification of mental and physical *events* (Davidson 1970b, 1970a). Proponents of the identity theory either in the metaphysics of dispositions or the philosophy of mind (and in several cases both), in various forms, include Place (1956), Feigl, Scriven, and Maxwell (1958), Smart (1959), Quine (1960, 1974), Lewis (1966), Armstrong (1968, 1977, 1973, 2005), Robb (1997, 2013), Heil (1999, 2003a, 2003b, 2011), Heil and Robb (2003), and Martin (2008).

erties include geometric properties, such as sphericity and squareness, and microstructural properties, such as being composed of H_2O or atomic lattices.[2]

How do dispositional and categorical properties differ? Whilst there does appear to be some difference between the two, that difference is notoriously elusive. In fact, reflection on usage reveals a range of ways the distinction has been drawn. Let me name a few.

The *first* is ontological. On this approach dispositional and categorical properties form distinct categories of existents (Ford 2012; Contessa 2019; Tugby 2020; Azzano 2021). Dispositions are properties with modally fixed causal profiles. In contrast, categorical properties have causal profiles that are modally variant (Bird 2016, sec.2.2). Some reserve the terms "power" and "quiddity" for this distinction which is, I think, a sensible approach. Importantly, on this view "categorical" simply means "non-dispositional". Evidently if *that* is what the identity theorist intends their theory is stillborn. But it seems clear they have no such distinction in mind. Even if all properties are powers, or if there are quiddities also, whether dispositions are identical to certain categorical properties remains an open question. To grant the identity theorist the fair trial they deserve, then, we must seek an alternative criterion.

The *second* is semantic. On this view the distinction lies not between properties but predicates (Quine 1974, 11; Armstrong 1999; Shoemaker 1980). More precisely, categorical and dispositional predicates differ in their intensions i.e., their conditions of application. In particular, the intensions of dispositional but *not* categorical concepts make essential reference to the ascribed property's effects. For example, the intension of "fragility" may be thought to make essential reference to breaking, smashing, or cracking. In contrast, whilst "being spherical" may be *associated* with certain effects, such as rolling or fitting in other shaped crevices and holes, the concept is not *defined* in terms of them. Put another way: only dispositional predicates are defined in terms of their manifestations.

The *third* is epistemological.[3] On this view dispositions differ from categorical properties in their apparent conditions of (non-inferential) perceptual

2 Some prefer to use the term "qualitative" as opposed to "categorical" (e.g., Martin 2008). If there is a difference between the use of these terms, I am unsure of it. If they prefer, friends of the qualitative/dispositional distinction may substitute talk of categoricity with talk of qualitativity throughout.

3 I take this primarily from Molnar (2003, 167). For similar views, though, see Ellis (2002, 28–70) and Mumford and Anjum (2011, 480).

knowability.[4] Whilst dispositional properties appear to be perceptually knowable only by witness of their manifestations, categorical properties appear to be so knowable throughout the persistence of their instantiation. In a sense, dispositions are the apparently "hidden" or "inconspicuous" properties of objects and contrast with their relatively "conspicuous" categorical cousins. The dual notions of "dispositional" and "categorical", on this view, denote the respective presence and absence of an apparent kind of *perceptual concealment*. Dispositions are the apparently perceptually inconspicuous persisting properties borne by objects. Categorical properties are unlike dispositions in that they do not appear to *lie latent*. It is this concealment, perhaps, that gives dispositions their distinctively "spooky" flavour and which moves us, as Goodman (1955) wrote, to bring them down to earth.[5]

For present purposes we needn't commit to either the semantic or the epistemological view. To investigate the identity theorist's dialectic we need only grant that some plausible distinction exists. And so long as we are concerned only with the internal dialectic of their theory, we must. Furthermore, if we focus on paradigmatic examples the exact nature of the distinction will not affect the arguments that follow. Hence, for the purposes of evaluating the retreat from type-type to token-token identity theories I'll assume there is some plausible distinction available to the identity theorist.

4 "Apparent" here is the operative word: if the identity theory is correct then the fragility of a glass merely *seems* to lie in wait. If the distinction were not one of mere appearance the identity theory would again be stillborn: there is no set of conditions under which a property is both knowable and not knowable. Traces of this view may be found in Goodman (1955, 40) who held that dispositional properties are "unobservable".

5 The epistemological conception is not without its difficulties. On the one hand, it may be held that perceptual knowledge is *always* the manifestation of a disposition, rendering the distinction inert. On the other, it may be argued that dispositions are perceptually knowable without witness of their manifestations. An athlete's strength, for example, may be known by perceiving the shape of their arms. Recognising this, Mumford and Anjum (2011, 480) offer a subtle account according to which dispositions are *originally* known by witness of their manifestations, and subsequently knowable via a blend of perceptual and inferential capacities.

But there is one reason, I think, that speaks in favour of the epistemological view. Whilst the epistemological criterion may explain why we have a semantic criterion, the converse fails. Whilst it is not because they are conceptually distinct that dispositions and categorical predicates differ epistemologically, plausibly it *is* the epistemological difference that gives rise to the semantic distinction. We have both dispositional and categorical predicates, perhaps, precisely because the properties are known via distinct perceptual modes.

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2 The Argument from Causal Roles

Why accept THE IDENTITY THEORY? One influential argument employs the

> CAUSAL IDENTITY PRINCIPLE. Two properties P, P' are the same property just in case P and P' bestow the same total causal role R to their bearers.

The CAUSAL IDENTITY PRINCIPLE is Eleatic in spirit: it is causal efficacy that gives a property its ontic bite. But the principle goes further. Causal efficacy is not merely the mark of the sparse, but properties are individuated by the causal roles they bestow. The precise nature of a property's causal profile is what makes it the very property that it is, and that which distinguishes it from all distinct properties.

What are causal roles, and what is it to bestow them? Whilst this question is hardly straightforward, for present purposes we may bruit a rough view. For a property P to bestow a causal role R to some bearer x is for x to bear R in virtue of instantiating P. Causal roles themselves we may think of as sets of possible causal contributions. A property P bestows a causal contribution at a case α just in case P is causally efficacious in α.[6] For instance, if a force F is exerted on a rubber band in α which as a result deforms reversibly then the band's elasticity bestows a causal contribution at α. On the precise nature of being causally efficacious we may remain neutral, saying only that P is efficacious with respect to some effect e just in case e occurs in virtue of the instantiation of P. A property's total causal role R is the set of all causal roles P bestows. According to this criterion, since the causal contributions bestowed by "being water" are the same as those bestowed by "being H_2O" the properties are identical. In contrast, since the causal contributions bestowed by "being flammable" and "being cube-shaped" differ the properties are distinct.

Inquiry informs us that when a dispositional property manifests, certain categorical properties bestow causal contributions to that manifestation. When a disposition has some categorical property that bestows a causal contribution to its manifestations, that property is said to be its *causal basis*. For instance, the causal basis of the band's elasticity is its possessing certain polymer chains

6 A *case* on the present sense is a modified version of the Lewisian (1979) notion of a centred world, i.e., a triple of some subject, at some time, at some world. Cases on the present understanding are triples but we allow for individuals more broadly construed. Thus we may consider some match, at some time, at some world. For discussion, see Vetter (2014).

which are causally efficacious in its reversely deforming. With such discoveries to hand, the causal identity principle may be employed in an argument to The Identity Theory.[7] The identification holds between dispositional properties and their categorical causal bases. Letting "D" denote dispositional properties and "C" categorical causal bases, it runs as follows:

(1) For all D, there is some R such that D bestows R.
(2) For all D, there exists some C such that if D bestows R, C bestows R.
(3) If D bestows R and C bestows R, then $D = C$.
(C) For all D, there exists some C such that $D = C$.

To clarify, consider elasticity. Elasticity bestows a causal contribution to its bearers: elastic objects deform reversibly under stress. But that very same causal contribution is bestowed by the property of having polymer chains. Thus, by the right-to-left of the Causal Identity Principle, elasticity is identical to the property of having polymer chains. Since similar arguments may be run for all dispositional properties, we may identify dispositions and their categorical causal bases.

3 Distinct Realisation

The first two premises are vulnerable to attack. It has been argued that 1 is false since dispositions are not causally efficacious (Prior, Pargetter, and Jackson 1982; Rundle 1997). It has been argued that 2 is false since some have no categorical grounds.[8] In this paper, though, I wish to focus on a different, familiar worry: dispositions admit of *multiple realisation*, or to be more precise:

> Distinct Realisation. A property P is distinctly realised just in case there exist two distinct entities, x, y, such that Px and the causal basis for Px is C_1, and Py and the causal basis for Py is C_2, such that $C_1 \neq C_2$.

Consider flammability. In safety matches the causal basis of the property of being flammable is the property of having potassium chlorate, but in

7 See Mumford (1998). See Lewis (1966) and Peacocke (1979) for analogues in the philosophy of mind.

8 Molnar (2003) gives as an example the decay of the supermassive tau lepton which, as he correctly points out, are thought by our best physics to be both simple but capable of decay.

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other matches the flammability is based by distinct chemicals. In non-safety matches, for example, phosphorus sesquisulfide is typically used.[9] Similarly, an elastic metal may be elastic in virtue of its possessing not polymer chains but atomic lattices.

From the existence of distinct realisation, the transitivity of identity, and the right-to-left of the CAUSAL IDENTITY PRINCIPLE, a *reductio* that threatens THE IDENTITY THEORY may be run. It takes the following form:

(A1) If P bestows R and P' bestows R, then $P = P'$
(A2) D bestows R, and R is bestowed by C_1
(A3) D bestows R, and R is bestowed by C_2
(A4) $C_1 \neq C_2$
(1) $D = C_1$ *(A1, A2)*
(2) $D = C_2$ *(A1, A3)*
(3) $C_1 = C_2$ *(1, 2, transitivity of "=")*
(4) $(C_1 = C_2) \wedge (C_1 \neq C_2)$ *(A4, 3)*

Let's walk it through.[10] We start with the right-to-left of the CAUSAL IDENTITY PRINCIPLE (A1). Next we consider two objects that possess the same type of disposition but distinct categorical realisers: perhaps an elastic band and an elastic metal rod. The causal basis of elasticity in the rubber band is its possession of polymer chains (A2), but in the rod the basis is its possession of an atomic lattices (A3). Moreover, we know that the possession of an atomic lattice is a distinct property from the possession of polymer chains (A4). Since two properties are identical if they bestow the same causal role, it follows that elasticity is identical to the possession of polymer chains (1). But it *also* follows that elasticity is identical to the possession of atomic lattices (2). By the transitivity of identity, the possession of polymer chains is identical to the possession of atomic lattices (3). But *ex hypothesi* the possession of polymer chains and the possession of atomic lattices are non-identical properties. Absurdity is now revealed: we have generated a contradiction (4).[11]

9 These examples are simplified for the purpose of clarity.

10 See Prior, Pargetter, and Jackson (1982) for the original in the case of dispositions. See Putnam (1967) for the original in the philosophy of mind.

11 It might be worried that this argument is question-begging insofar as A3 has been assumed to be true. It could reasonably be argued that the two categorical properties are distinct given that their overall causal roles do not perfectly match. If no such properties can be identified, of course, the multiple realisability argument is a non-starter. For the purposes of evaluating the token

4 The Token Retreat

Faced with distinct realisation, what's an identity theorist to do? At first blush it is not tempting to reject any assumption. But since most are unwilling to deny A1, and A4 can hardly be doubted, A2 and A3 are the usual suspects. But on what grounds are they to be denied? In what follows I consider two options.

The *first* is to deny the datum: there is no distinct realisation. This will usually be motivated by the claim that such dispositions are not sufficiently sparse. One may, for instance, hold that there are identities between dispositions and their categorical bases only at the fundamental level (Bird 2007). Alternatively, one may accept macro-level dispositions but, like Heil (2004, 246–247), argue that the appearance of distinct realisation derives from the fact that we have a "*range of similar properties all satisfying a single, moderately imprecise predicate*".[12] Word making is not world making: there are many kinds of fragility, each of which is *not* distinctly realised.[13]

Consider how this affects A2 and A3. Since there are two similar though distinct causal roles we should reformulate the assumptions as follows:

(A2*) D bestows R_1, and R_1 is bestowed by C_1
(A3*) D bestows R_2, and R_2 is bestowed by C_2

But inconsistencies lurk. For now D bestows two distinct causal roles—by the Causal Identity Principle $D \neq D$! Thus *really* they should be formalised as:

(A2**) D_1 bestows R_1, and R_1 is bestowed by C_1
(A3**) D_2 bestows R_2, and R_2 is bestowed by C_2

and now the purported distinct realisation has been explained away. The elasticity of rubber bands is identical to the property of having polymer chains, the elasticity of metal rods is identical to the property of having atomic lattices. But since $\text{elasticity}_1 \neq \text{elasticity}_2$, contradiction is avoided.

Now, although I am sympathetic to this approach, in what follows I will assume that distinct realisation is no phoney phenomenon. And that is for the

retreat, then, I'll be assuming such properties can be found. Thanks to an anonymous referee for pressing me on this point.

12 See also Heil (1999).

13 No doubt, how plausible this seems will depend upon one's broader ontological commitments. For excellent discussion on the competing notions of sparseness, see Schaffer (2004).

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purpose of evaluating the *second* option, which takes multiple realisation at face value. This is taking the *token identity retreat*. Here are two philosophers doing just that:

> The monist wants to say that there is just one attribute of x, or state that x is in, that makes it true of x that Dx and that Cx. This requirement can be satisfied even if the extensions of D and C do not coincide. Thus there need not be an identity of universals for monism. [E]ach instance of a disposition is identical to some instance of a categorical base [this] amounts to a token-token identity theory. [...] This means that the argument from variable realization is disarmed [...] the same move, to token-token identities, is available for dispositions in response to the variable realization argument.[14] (Mumford 1998, 159–161)

> But I did miss something important, though. If the mental is nothing but that which plays a certain *causal role* [...] then there is the possibility, which may even be an *empirical* possibility that the total causal role of tokens of the same mental type should be filled by tokens of significantly different physical types. Instead of type-type identity, one might have no more than a mental type correlated with an indefinite disjunction of physical types [but] every mental token is a purely physical token.[15] (Armstrong 1968, xv)

As formulated, the argument requires that for all dispositional properties D, there is some unique type of categorical property C such that for any D-instance Dx, some C-instance Cx is responsible for the causal contributions of Dx. What cases of multiple realisability show is that, for many dispositions at least, there is no such type of categorical property. Different objects may bear the same dispositional property, despite the manifestations occurring in virtue of categorical properties of distinct types.[16]

14 Note that Mumford uses the term "variable realization" here to mean what I have called distinct realisation, and not what I will go on to call variable realisation.

15 Note that while Armstrong is speaking of mental and physical properties here, he identifies (at least non-occurrent) mental states with some dispositional properties. See Armstrong (1968, 88; 1973, 14).

16 The token identity theory in the philosophy of mind seems to be entailed by what Kim (1992, 18) dubbed the "Causal Inheritance Principle":

In contrast, a token identity theory makes no such demand. All that is required is that *each token* of a dispositional property Dx is identical to a token Cx of *some* property C. C need not take a unique value. The rubber band's elasticity is identical to its polymer chains, the metal rod's elasticity is identical to its atomic lattice. But there is no requirement that the property of having atomic lattices is identical to the property of having polymer chains. Thus, whilst A2 and A3 are both false, it matters not.

But if only tokens are identified, what of the types? Several alternative treatments are available. According to the *first* there are no types, only resemblance classes of individuals. All properties are particular; property "types" are merely classes of resembling property tokens. Categorical and dispositional properties, on this view, are simply distinct classes of property tokens or "tropes" individuated by the differing respects in which their members resemble. And so multiple realisability causes no sweat: a metal rod's elasticity may be similar to the elasticities of all elastic objects, and its atomic lattices may be similar to all other atomic lattices, even if all of the former class do not resemble all of the latter. A token may resemble one class in certain respects, and another class in other respects, with no pain of contradiction.

Again, although I am sympathetic to this approach the present arguments assume a different conception of tokens and types. Not for the reason that the conception is implausible, but simply because it is not relevant to the arguments that follow. For on this view there is in a sense no *bona fide* multiple realisability: the argument is avoided by banning types from our ontology. I have no doubt that an ontology which rejects universals but embraces tropes provides an alternative route to mere token identification. Let me be clear: if that is one's motivation, so be it. If they feature in a fruitful metaphysics, let tropes bloom. The present gripe is not with endorsement of token identities *per se*; I am interested only in the adoption of token identity in response to the problem of distinct realisation.

According to the *second*, which we saw Armstrong endorse above, the types are disjunctive. Elasticity is identical to the property of having *either* atomic lattices *or* polymer chains *or* so on and so on; possibly *ad infinitum*. According

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It is important to bear in mind that this principle only concerns the causal powers of *individual instances of M*; it does not identify the causal powers of mental property *M in general* with the causal powers of some physical property *P*; such identification is precluded by the multiple physical realizability of *M*.

For an analogous move, see Robb (1997, 188).

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to the *third* the types are higher-order. Not "higher-order" as in "property of property", but rather "the property of bearing a property of such-and-such sort". For instance, being fragile may be thought of as having a property that bestows a certain subset of a causal role.

With the disjunctive and higher-order views, though, a natural question may arise: wherein does motivation to endorse token identity lie? Answer: such views are notoriously difficult to square with the causal individuation of properties. Both higher-order and disjunctive properties appear entirely sterile: their causal powers seem preempted or excluded by the categorical properties that base them. And by the Eleatic principle, sterile properties are properties only in an abundant sense.

But by identifying tokens—so the story goes—dispositions appear powerful again.[17] If only dispositional types are shown to be sterile, what of it? It is property tokens that are standardly taken to be causally efficacious in any case (Campbell 1990). With identities maintained between token dispositions and their token categorical bases, no exclusion or preemption is achieved. And thus against the charge of inefficacy the identity theorist is in the clear.[18]

But the CAUSAL IDENTITY PRINCIPLE applies to types, not tokens. And the token retreat identifies tokens, not types. So how is identification to be achieved? Whilst properties are individuated in terms of their causal roles, property instances are typically not. There are, rather, two competing views on their individuation. According to the first property instances are individuated *spatiotemporally*. For instance, Schaffer (2001) argues that two property instances Px, $P'y$ are the same property instance just in case Px and $P'y$ are compresent and maximally resemble. Alternatively, tokens may be taken to admit of brute individuation.

This debate, though, largely takes place amongst those who embrace tropes, on whom there is an onus to provide individuation. With that in mind, there seems no reason why the friend of universals cannot maintain that property instances admit of causal individuation. Property instances do bestow causal roles: token causal roles. A token causal role is obtained by restriction. We

17 See Shoemaker (2013, 46). Strictly speaking, Shoemaker endorses a variant on the identity theory: the *subset* theory, according to which a dispositional property is identical to some part of its categorical base. For the original exposition of the subset theory, see Wilson (2011). The subset theory will be unaffected by the arguments that follow and is thereby corroborated by them.

18 Interestingly, Mellor (2000) embraces the possibility of disjunctive properties being causally efficacious, though to achieve that result he explicitly rejects the existence of dispositional properties, and thus the identification between them and their categorical bases.

look not at the set of cases of causal contributions of the property across all instantiations, but only given some particular instantiation. For example, we might look at the set of cases of causal contributions *this heat* from *this very stove* might confer.

But whilst appeal to causal roles may be *necessary* to individuate property instances it cannot be *sufficient*. For we must exclude scattered instances, such as a property instance of "red" belonging to both a ruby and a rose, and distinguish distinct property instances borne by the same object at distinct times, such as the distinct greens of a chameleon's skin before and after changing to a vibrant orange. None of this is troublesome. We must simply provide two supplements. The first is that the instances are *coinstantiated* (i.e., borne by the same object), the second that they are *concurrent* (i.e., instantiated at the same time). Putting all of this together, we have the following criterion of property instance individuation:

> Token Causal Roles. Two property instances Px, $P'y$, are the same property instance just in case $x = y$, Px is concurrent with $P'y$, and Px and $P'y$ bestow the same token causal role R.

With that to hand, an argument to the token identity theory can be run. Here it is:

(1) For all Dx, Dx bestows some token causal role R.
(2) For all Dx there exists some Cx, such that Cx is concurrent with Dx and Cx bestows R.
(3) If Dx is concurrent with Cx and both Cx and Dx bestow R, then $Dx = Cx$.
(C) For all Dx, there exists some Cx, such that $Dx = Cx$.

As before, the first two premises are vulnerable to attack. It has been argued that both are false, as property instances are not causally efficacious (Steward 1997). And if some dispositions have no categorical grounds, the second premise faces the same threat. But again, permit me to set these worries to one side. In what remains of this paper I will argue that the token retreat is ill-motivated. And that is because problematic multiple realisation is *not* a distinctively type-type phenomenon. There is problematic multiple realisation at the token level. The upshot is: if one is worried about multiple realisation, retreat to the token level is dialectically inert.

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5 Plural Realisation

Some dispositional properties are not based by a unique token of any causally efficacious property. I call these *plurally realised* dispositions. Plural realisation should be contrasted with

> VARIABLE REALISATION. A property P is variably realised just in case there exists an entity x, such that Px at t_1 and t_2, and the causal basis for Px at t_1 is C_1, but the causal basis for Px at t_2 is C_2, such that $C_1 \neq C_2$.

Variably realised properties are well discussed.[19] Pereboom (2002) considers the realisation of a statue by distinct lumps of clay across time, whilst Hurley and Noë (2003) consider cases of neural plasticity where mental properties are based by changing neurological complexes. Similar cases are constructible for patently dispositional properties. Consider a vial containing the poisonous chemical DEATH_1. Now let DEATH_1 decompose into DEATH_2 from t_1 to t_2. In such a case, the deadly disposition is variably realised across time.

How troublesome is variable realisation for one who takes the token retreat? Quite, though non-fatal. The purported worry is that the persistence conditions of the properties come apart from those of the bases. But time-indexing the identity relation is the standard counter-move.[20] Property tokens exist only at one moment, and so their identities hold only at one instant. DEATH_1 is identical to the poisonousness at t_1, and DEATH_2 to the poisonousness at t_2, but x's poisonousness at $t_1 \neq x$'s poisonousness at t_2. And without token persistence, no transitivity can be exploited. The upshot is: arguments from variable realisation lose their bite.

Not all will agree.[21] But even if one accepts property instance persistence, retreaters to token identity are still liable to balk. That properties maintain their identity through time does not rule out that in cases of variable realisation one property is lost, another gained. Consider a pill x composed of both some benign mixture and DEATH_1. Now remove the DEATH_1—x will lose its token disposition. Now consider x with the DEATH_1 removed and add to it DEATH_2. A token disposition (assuming no reactions take place) will be gained: it will become poisonous. Now put the cases together: let DEATH_1 and DEATH_2

19 See Horgan (1993), Endicott (1993), Pereboom (2002).
20 See Heil (2011, 44), Campbell (1990, 140), and Wilson (2011, 141).
21 See Shoemaker (2007, 3fn3).

be exchanged. Why should matters change? One token disposition should be lost, another gained. The identity theorist will maintain that no disposition outlasts the persistence of its base. Even granted that tokens persist, in cases of variable realisation it may be argued that the persistence conditions of disposition and base do not come apart.

But there are cases that cannot be so readily dispensed with. And that is because such cases involve *intra*-object multiple realisation accompanied by *no* change in properties. I called this

> Plural Realisation. A property P is plurally realised just in case there exists an entity x, such that Px, and Px has two causal bases, C_1, C_2, such that $C_1 \neq C_2$.[22]

Plurally realised properties are ones which have more than one causal basis in the same object at the same time. For clarity, we should make a (non-exclusive) distinction between properties that are *wholly* plurally based, and those that are *partially* plurally based. Consider a lighter's disposition to ignite once sparked. This disposition is based by both the fuel, the flint, and the sparker all at once. But each of these is individually insufficient to base the disposition. It is therefore partially but *not* wholly plurally based. If the disposition is to manifest, the three bases must act *holus bolus*.

A property is wholly plurally realised, in contrast, when it has two or more distinct sufficient causal bases. Consider Mackie:

> Even in the same material, the same disposition may have more than one ground. A piece of cloth may absorb water in two ways, by the water being taken into the individual fibres and by its being held in spaces between the fibres: its absorbency then has two different bases, the molecular structure of the fibres and the larger-scale structure in which those fibres are spun and woven. (1973, 148)

For another example, cigarette smoke has the disposition to damage the lungs once inhaled, but that disposition is based distinctly by a wide variety of chemicals present in the smoke's composition. In fact, cases are constructible with the following straightforward recipe. First, take two cases of *distinct*

22 I have restricted attention to doubly based dispositions, though evidently we could consider dispositions with any finite number of bases.

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realisation, where the properties are capable of being coinstantiated. Perhaps a poisonous vial y of DEATH_1, and a distinct poisonous vial z of DEATH_2. Next, simply coinstantiate the properties, as in:

> OVERKILL. A vial of poison x contains two deadly chemicals DEATH_1 and DEATH_2. Because of this x has the disposition to kill when ingested.

And *voilá*! A case of token multiple realisation has been constructed. In OVERKILL the mixture's poisonousness is based twice-over in the same object. As such the disposition is multiply realised at the token level. And, as I will now show, plurally realised dispositions with distinct whole bases, such as the vial's poisonousness in OVERKILL, are as problematic for the token identity theorist as distinctly realised dispositions are for the type identity theorist.

The argument now begins. From the existence of plural realisation, the right-to-left of TOKEN CAUSAL ROLES, and the transitivity of identity, a formally analogous *reductio* may be run. It takes the following form:

(A5) If Px and $P'x$ are concurrent and bestow the same token causal role R, then $Px = P'x$
(A6) Dx and C_1x are concurrent and bestow R
(A7) Dx and C_2x are concurrent and bestow R
(A8) $C_1x \neq C_2x$
(5) $Dx = C_1x$ (*A5, A6*)
(6) $Dx = C_2x$ (*A5, A7*)
(7) $C_1x = C_2x$ (*5, 6, transitivity of "="*)
(8) $(C_1x = C_2x) \wedge (C_1x \neq C_2x)$ (*A8, 7*)

Again we'll walk it through. We start with the right-to-left of TOKEN CAUSAL ROLES (A5). Then we note that x's poisonousness is concurrent with x's being composed of DEATH_1, and both occupy the same token causal role (A6). Next we note that x's poisonousness is concurrent with x's being composed of DEATH_2, and both occupy the same token causal role (A7). Finally, we know that $\text{DEATH}_1 \neq \text{DEATH}_2$ (A8). It follows that x's poisonousness = DEATH_1 (5). But it also follows that x's poisonousness = DEATH_2 (6). By the transitivity of identity, $\text{DEATH}_1 = \text{DEATH}_2$ (7). Absurdity is again revealed: we have generated a contradiction (8).

Crucially, the contradiction is derived from premises that involve token, not type identifications.

6 Responses and Replies

I have argued that the token retreat offers no solace from the problem of multiple realisability. How might the token identity theorist respond? In what remains I consider three responses. My strategy for dealing with them is as follows. I will argue that each faces an unpalatable disjunction: either (1) that response can be shown to fail, or (2) is available at the level of types.[23] The upshot of (1) is that multiple realisation has not been avoided. The upshot of (2) is that the token retreat is robbed of its dialectical force.

The *first*, and no doubt the most natural response, is that the basis in OVERKILL is complex. It may be thought, for example, that the disposition is identical to the conjunctional property (DEATH_1 & DEATH_2).[24] Why so? One reason would be that both DEATH_1 and DEATH_2 share the dirty work when the poisonousness manifests. They *together* occupy the relevant token causal role. They are causally efficacious both at once.

This line of thought is convincing, but misleadingly so. It seems to have force due to the mistaken assumption that the total causal role bestowed by the disposition must be identical to that bestowed by the conjunction of the chemicals. The assumption is false: there are some plurally realised dispositions where the conjunction of that disposition's bases bears a distinct token causal role from the disposition itself.

Consider what we may call *disjunctively realised* dispositions. A disposition Dx is disjunctively realised just in case it has two bases C_1x, C_2x, such that the manifestations of Dx in some cases occur in virtue of C_1x, and not C_2x, in other cases in virtue of C_2x and not C_1x, and in all other cases (if any remain) by $(C_1x \,\&\, C_2x)$. Disjunctive realisation is possible because distinct bases of the same dispositional property may differ in their conditions of *masking*, i.e., the conditions under which the basis is rendered inefficacious.[25]

For example, suppose that some humans are perfectly resistant to DEATH_1 but not DEATH_2, whilst others are perfectly resistant to DEATH_2 but not DEATH_1. Now consider:

23 The disjunction here is inclusive.

24 For clarity I'll be using "&" to denote the relevant property-theoretic notion of conjunction, whatever it may be, to distinguish it from the familiar, truth-functional notion (denoted by "∧").

25 See Bird (2007, 39). For more on masking, see Johnston (1992), Bird (1998), Molnar (2003), and Martin (2008).

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> RESISTANCE-1. Jones ingests x. Jones is perfectly resistant to DEATH_1. Unfortunately Jones is not at all resistant to DEATH_2, and thus as a result of ingesting x Jones dies.

> RESISTANCE-2. Smith ingests x. Smith is perfectly resistant to DEATH_2. Unfortunately, Smith is not at all resistant to DEATH_1, and thus as a result of ingesting x Smith dies.

Suppose, as our responder would have us believe, that in RESISTANCE-1 and RESISTANCE-2 the vial's poisonousness is identical to the conjunctional property (DEATH_1 & DEATH_2). From this we may show what we know to be false: that both chemicals are causally efficacious in the death of Smith and the death of Jones.

The conclusion is a consequence of two principles. The first is a straightforward consequence of TOKEN CAUSAL ROLES. I call this the

> IDENTITY OF CAUSES. If Px bestows a causal contribution c in α, and $Px = P'x$, then $P'x$ bestows c in α.

The principle follows because token causal roles are sets of possible causal contributions. If two properties share causal roles they must share all of their possible causal contributions. So if a property bestows a causal contribution c, and is identical to some other property, that other property must also bestow c.

The second is not a consequence of TOKEN CAUSAL ROLES but is independently plausible. I call this

> CONJUNCTIONAL CAUSES. If $(Px \,\&\, P'x)$ bestows a causal contribution c in α, then Px bestows part of c in α and $P'x$ bestows part of c in α.

This principle simply states that whenever a conjunctional property bestows a causal contribution c both conjuncts bestow some part of c. My reasons for accepting TOKEN CAUSAL ROLES are broadly Eleatic. We should accept that a conjunctional property bestowed a contribution only if both conjuncts had some causal stake in the game. Consider an object o with two properties: o is round and red. Now suppose the conjunction of the two properties is causally efficacious in some case α, perhaps by contributing to the opening of a door that has been designed to open only in the presence of round and red objects.

Now in such a case we should say, given that the conjunctional property bestows a causal contribution, each of the conjuncts bestows some part of that causal contribution. In contrast, now suppose the door is primed only to open in the presence of red objects, no matter their shape. If the roundness makes no causal contribution to its opening in α, then the conjunction of its roundness and redness *does not* bestow a causal contribution in α. The causal contribution is bestowed merely from one conjunct.

We are now in a position to reject the response. For suppose, as the respondent has claimed, that the vial's poisonousness is identical to the conjunctional property (DEATH_1 & DEATH_2). Since the vial's poisonousness is causally efficacious in both cases, by Conjunctional Causes it follows that both DEATH_1 bestows a causal contribution to the death of Jones, and DEATH_2 bestows a causal contribution to the death of Smith. But *ex hypothesi* Jones is perfectly resistant to DEATH_1, and Smith to DEATH_2, thus the chemicals *do not* bestow the relevant causal contributions. We have proven what we know to be false. The reply must be denied.[26]

Conjunctional won't work; might disjunctional do the trick? Not obviously, for even setting aside the shameful status of disjunctive properties, the problem of causal exclusion re-arises.[27] Just as with disjunctive types disjunctive tokens have nothing to contribute: their contributions are given by their disjuncts alone. And without causal efficacy no identification can be achieved, at least not by appeal to sameness of causal role.

And worse still, once disjunctive tokens have been admitted motivation to move to the token level is lost. For if one is prepared to accept disjunctive tokens, why not disjunctive types? If one is content to retreat to the disjunctive in the face of *plural* realisation, why not in the face of *distinct* realisation? Simply put: to maintain disjunctive tokens whilst denying disjunctive types creates a dissonance entirely unwarranted by the presence of multiple realisability.

The *second* response is that we should say that in Overkill there are two or more distinct tokens of the same dispositional type. This results in a

26 Could it be argued that the dispositions in such cases are merely borne by the mixture's parts, rather than the mixture taken as a whole? Possibly, though this will be more difficult to argue in other cases. Consider a disjunctively realised belief. It would be strange to deny that the belief is a property of an agent taken as a whole and to attribute instead the belief to parts of the agent. Thanks to an anonymous reviewer for raising this insightful objection.

27 See Putnam (1967), Armstrong (1978), Lewis (1986), Kim (1992), Shoemaker (2007) and Audi (2013). Heil (2003a, 40) goes so far as to say that "disjunctive property" is oxymoronic. For a defence of the disjunctive, though, see Skiles (2016).

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commitment to what Armstrong (1978, 86) has called *piling*.[28] Two property instances are piled just in case they (1) are of the same type and (2) are compresent (i.e., instantiated in the same object at the same time). Piling is standardly taken to be a serious bullet to bite. Those who embrace it do so tentatively, in accord only with the Eleatic principle.

Fortunately enough we may dodge the issue entirely. Consider again the vial containing the deadly chemicals. Could the vial's deadliness be piled? Not if the piled dispositions are identified with the distinct chemicals. This is due to what we may call the

> RELATA OF IDENTICALS. If $P = P'$, then P stands in some relation R iff. P' stands in R.

Since piling is a relation amongst properties, if there are two piled dispositions of the same type, one based by DEATH_1 and the other by DEATH_2, it should follow that DEATH_1 and DEATH_2 are piled. But the chemicals are *not* piled—they are of distinct types. By *modus tollens*, then, it cannot be said that the dispositions are of the same type.

The *third* response is that disjunctive realisation involves multiple property instances of *distinct* types. Perhaps in OVERKILL the mixture has two distinct dispositions (one identical to DEATH_1, the other to DEATH_2) or even three (the third being identical to the conjunction of the two). In response I offer an argument designed to show that there are at least some disjunctively realising bases that genuinely do base the same disposition. It runs as follows.

The first premise is that dispositions are wholly individuated by their manifestations.[29] Flammability is distinct from elasticity because flammability makes objects *burn* whilst elasticity makes objects *reversibly deform*.

The second premise is that plurally realised properties may bear bases that differ with respect to their masking conditions, but not with respect to their manifestations. This is possible because two distinct properties may share a subset of their causal role relevant to the manifestation of some disposition, whilst bearing a distinct subset relevant to their masking.

Perhaps the most vivid examples may be found not in deadly chemicals, but in deadly bacteria. E. coli (*Escherichia coli*) has a number of pathogenic strains including the shiga-toxin producing O104:H4. Like other co-evolved bacteria, E. coli strains change their properties of resistance over time—and thus the

28 See also Schaffer (2004)

29 For defence, see Molnar (2003), Lowe (2011), Mumford and Anjum (2011), and Vetter (2014).

conditions under which their deadly disposition is masked. This may be done in several distinct ways: bacteria may develop the capacity to "pump out" or neutralise antibiotics, or they may produce subtle changes in their binding sites. Consider now a vial containing several shiga-toxin producing strains that base a deadly disposition. The *manifestations* of the various strains may be identical (i.e., perfectly similar)—and thus by the criterion of manifestation individuation the vial has only one deadly disposition. Nevertheless, the masking conditions of the individual strains may vary.

The conclusion is that some distinct disjunctively realisable properties base the very same dispositional property.

I anticipate one final worry. Perhaps one will hold that dispositions are individuated in part by their stimulus conditions, and are thus of a finer grain (Martin 2008, 89–91). This would make the first premise false. In which case there will be two tokens of distinct types even in the case of E. coli. But to this worry I say: now you have liberalised your ontology with properties of a finer grain *why take the token retreat at all*? The dissonance faced by the proponent of disjunctive tokens re-emerges: if one accepts distinct properties *intra*-object, why not *inter*-object also? If one chooses to fine-grain dispositional property instances to avoid *plural* realisation, why not fine-grain dispositional types to avoid *distinct* realisation? If the properties are of a finer grain, and hence distinct, there is no need to move from type to token identifications, since the response holds *mutatis mutandis* for the proponent of the type identity theory. To maintain the retreat one must offer an independent reason not to fine-grain dispositional types. The point I am making is not that such reasons cannot be given. My point is that if there are reasons, multiple realisation is not amongst them.

In conclusion, I have argued that the token retreat offers no solace from the problem of multiple realisability. Whilst it may avoid *distinct* realisation, it cannot avoid *plural* realisation. Whilst there are responses to the latter that are not available to the former, each of those responses fails. The upshot is: there is no relevant difference between these types of multiple realisation *vis-à-vis* the identification of dispositions and their categorical bases. And as such, no ground is made by moving from the type to the token level.*

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Niall J. Paterson
0000-0003-1178-0463
Bristol
United Kingdom
niall.paterson@pm.me

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