Title: The Categorical-Dispositional Distinction

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We have an overwhelming sense of the world as containing spatially-oriented distinct objects, and it seems that we derive this sensation from the properties of things as revealed by their effects upon us. This paper asks what sorts of properties should be posited to exist in accounting for this ostensibly qualitative, yet powerful, world.

My stance is a field-theoretic view, akin to Rom Harré's 'Great Field' (Harré, 1970; Harré, 2001; Harré & Madden, 1975; Madden, 1972), that describes the world as a single system comprised of pure power. Although it is outside the scope of this paper to detail such a pure-power ontology, here I defend the claim that structure should be considered in terms of pure-power rather than categoricity. This involves the further contention that 'pure-power' should not be interpreted as 'pure dispositionality', in the sense of potentiality, possibility or otherwise unmanifested power or ability bestowed upon a bearer. Rather, I view power as ontologically robust, characterised in terms of *effect*, envisaging it as closer to Brian Ellis's notion of 'energy transmission' (2002, 2010) than to traditional ideas of dispositionality.

One major difference between my Foundation-Monism and Ellis's New Essentialism concerns the object level, at which Ellis assumes distinctness of objects and then builds-in an ontologically-robust distinction between their categorical and dispositional properties. This distinction between property-types is posited in terms of passive versus active causal roles—what a property *is* versus what a property *does*. If categorical properties were ontologically-robust at higher levels, it would seem

consistent that they obtain similarly at fundamental levels. In this case, it would be reasonable to expect that such property-dualism involves fundamental categoricity.

In this paper, I argue that the causal role of properties appearing as active or passive is tied very closely to whether the relevant properties of an object are deemed intrinsic and essential or extrinsic and contingent, respectively. However, such a difference can occur only in ontologies whose objects are distinct. For those positing objects as merely supervenient—as non-distinct regions of a unified system—the distinction between intrinsic versus extrinsic properties borne by those regions, like the active versus passive and the categorical versus dispositional distinctions, does not apply in the ontologically-robust manner required for carving up reality into different property types. I suggest, instead, that these distinctions appear to arise at the object-level by virtue of the assumptions built into the concept of object-hood; and stand as an instrumental, albeit useful, abstractions.

Applied to this view, consistency seems to demand that ontologically-robust categorical properties may not exist at higher-levels if not at fundamental levels. Such elimination of categorical properties is supported by Strong Dispositional Essentialists, whose position is compatible with, but does not entail, a stronger claim that all properties are dispositional. I argue against this stronger claim because it appears to involve the dubious assumption that non-categoricity amounts to dispositionality. Distinguishing between 'pure power' and dispositionality, I contend that: i) there are no ontologically-robust categorical properties, although the appearance of them may be accounted for as higher-order and supervenient; ii) that the fundamental ingredients of the universe can be described in terms of pure-power, which is neither categorical nor dispositional; and iii) that the categorical-dispositional distinction arises only at the 'object-level', although this is not in any

case an ontologically-robust division of reality between two different natures in the sense described by Stephen Mumford (1998, p. 95).

1. Dimensions

Traditionally, both dispositional and categorical properties have been put forward in attempts to describe the manifest world. They have often, although not always, been defined in mutually exclusive and somewhat oppositional terms. Brian Ellis notes that categorical properties have been considered readily imaginable (Ellis, 2002, p. 68); existing independently of behaviour (pp. 68-69); multi-dimensional (p. 69); structural (pp. 69-70); non-dispositional or non-modal (pp. 70, 117); and grounding or realising of the dispositional (pp. 174-175). Adopting the concept of quiddity, described by Alexander Bird and Robert Black as referring to some 'nature' of properties independent of their causal roles (Bird, 2006; Black, 2000; Ellis, 2008a), Ellis asserts that categorical properties are quiddistic in the sense that they have their identity by virtue of what they *are* rather than by what they *do* (Ellis, 2010). Categorical properties have by and large been characterised in terms of spatially-extended or space-occupying properties represented by Lockean primaries of size, shape, solidity and so on (Locke, 1924, II, Ch. VIII, 8, 66). Charlie Martin, for example, describes qualitative properties as those needed for things to be perceived, providing the 'what' or 'shell' of objects (1997); and John Heil describes them as what individuates or differentiates powers (2007). Others describe their status as 'actual' or ontologically-robust (Place, 1996), or focus on their self-containment in terms of 'completeness' in their instantiation. David Armstrong describes them as 'exhausted' in their instantiation by particulars, whereby they do not reserve of themselves for further

interactions with other particulars (Armstrong, 1989, p. 118; 1997, pp. 41, 69, 245). Bird describes them as properties that have primitive identity (2007, p. 45). Strong Categoricalists, such as Armstrong, hold that all properties, including those at the fundamental level, are categorical.

Dispositional properties have been contrasted with categorical properties in all of the descriptive contexts above. As Ellis points out, dispositional properties have been considered uni-dimensional (2002, 69); non-structural (2002, 69-70); essentially modal (2002, 70); and grounds for the categorical (2002, 174-175). In this volume, Ellis defines dispositional properties as those that obtain their identity by virtue of what they dispose their bearers to *do* (Ellis, 2010). Dualist positions, such as the New Essentialism advocated by Ellis[1] (2001b, 2002, 2008b, 2010), hold that dispositional and categorical properties present a real difference in category between dispositional and categorical properties (2010), whose mutual exclusion is based upon whether a property is structural or not (2002, p. 70). For Ellis, although both types play causal roles (2001b, pp. 9-10; 2005b, p. 470), dispositional properties include causal powers, identified by the power that they bestow upon their bearers. In contrast, categorical properties—such as sizes, shapes and spatiotemporal relations and locations—obtain identity in virtue of what they *are* rather than what they *do*. Their causal role is passive, being that of merely 'factors' (Ellis, 2010), rather than of driving forces, in the operation of causal processes.

Importantly for Ellis, categorical properties are structural properties, and he relies on these to underpin his natural-kinds hierarchy and its central tenet—that ontologically-robust structure is built into the universe (Ellis, 2001a, p. 174; 2001b, p. 2; 2002, p. 68; 2005a, p. 382; 2008a). This dependency on structure requires it to

[1] First posited jointly with Caroline Lierse (Ellis & Lierse, 1994).

exist at fundamental levels and to include spatiotemporal relations, as he considers space and time to be 'the pure forms of physical structure' (Ellis, 2002, p. 174). To accommodate current theories of physics, Ellis leaves open the idea that quantum fields might be fundamental quiddities, replacing the Lockean quiddities of Newtonian mechanics (2010). Yet, as he observes, neither structure as relations between parts (Ellis, 2001b, p. 10; 2008b, p. 143), nor objects themselves (Ellis, 2010), exist at fundamental levels. In this volume, Ellis describes the distinction between dispositional and categorical properties *at the object level* (Ellis, 2010). One reason is because it is only at this level that talk of 'physical objects that are the bearers of causal powers' (Ellis, 2010), and hence of spatiotemporal relations between objects, has meaning. Consequently, structure is portrayed by Ellis in two different ways: first, higher-order block structure (2001b, pp. 10, 247); and second, the kind of quiddities, regardless of whether Lockean or quantum mechanical, that feature as fundamental categorical properties (2001b, pp. 138, 218; 2002, p. 70).

Since they provide the structural component of the universe, New Essentialism's properties are almost all counted as dimensions. Ellis describes dimensions as the quantitative properties that are involved in the laws of nature (2010), which direct how the effects of causal power are distributed (Ellis, 2001a, 2008a). The effect of a causal process is to change the values of certain dimensions, and Ellis describes these dimensions as 'respects in which things may be the same or different' (2008a). They 'determine the structural frameworks within which the powers operate' (Ellis, 2001a, p. 174) and include, for example, quantities, shapes, duration, direction, spatiotemporal separation, position and time (Ellis, 2001b, pp. 136-138; 2008a). While the dimensions include most, if not all, of the categorical properties, they also include certain causal powers, since causal powers and

capacities, like categorical dimensions, also represent 'respects in which things can be the same or different' (Ellis, 2008a). I refer to the latter as 'powerful dimensions'.

The dimensions are 'determinables' (e.g. mass), each with at least two possible values or 'determinates' (e.g. 5 kg of mass), one of which is actual; and necessarily the dimensions are more ontologically fundamental than their values—mass must exist before one can have five kilograms of it. Importantly, the dimensions are not constituted by their values. Mass, for example, exists as something over and above the fact of being quantifiable. Ellis sees dimensions as 'among the fundamental constituents of reality at the object level' (2010). However, rather than denoting dimensions as being actually fundamental, his specifying the 'object level' here leads me to interpret him as meaning that dimensions are *actually present* in the world in the sense of being ontologically-robust; his dimensions exist over and above their respectively many instantiated values.

The role of dimensions is to provide the circumstances in which the laws of action occur. How they do this is crucial to what the dimensions are. In his paper in this volume, Ellis provides the example of a weight suspended above ground level with the causal power to compress, stretch or pull things by virtue of potential energy. How the power manifests depends on the relevant circumstances, e.g. where the weight is in relation to other things, how it is fixed in position, and so on. The law of action concerns the effect of the weight in terms of the strength of the causal power as a function of the dimensions and initial circumstances. Ellis notes that all such laws of action are quantitative, depending on the magnitude and location of relevant powers; and that all involve one or more categorical properties, these categorical properties comprising the dimensions or circumstances in which the powers operate.

In this view, given that both dispositional and categorical properties may represent dimensions, being a dimension *per se* does not render a property categorical; being structural or quiddistic does. This raises the question of how a categorical dimension differs from a dispositional or powerful one *with respect to what role dimensions play* in general. For example, if the role of dimensions is to fix the circumstances for the action of laws by virtue of being 'passively' structural or quiddistic, then an 'active' dispositional property, such as mass, cannot be regarded as a dimension in these terms. And conversely, if dispositional properties are counted as dimensions, as Ellis suggests, then fixing the circumstances for the action of causal power is not the only role that dimensions play. In this case, properties that provide the structural circumstances cannot be deemed categorical merely on the basis that they are dimensional; and it is clearly not the fact of being dimensional that is crucial to Ellis's argument for the existence of categorical properties.

Ellis claims that categorical properties are quiddistic by virtue of being structural; such that they contribute to the circumstances for the operation of laws of action according to what they *are* rather than what they *do*. On these grounds, however, being a dimension *per se* does not justify counting structure as categorical rather than powerful. Instead, it is the claim for structure being *quiddistic* that purportedly renders it categorical.

2. The passive causal role of categorical dimensions

A difficulty—captured in the argument from quiddity—is encountered if the identity of a structural property is determined by means other than its causal role, since it would seem that, apart from some ability to engage in a causal process leading to our

perception of such a property, we could not know anything about it. This problem appears to have been avoided by Ellis because his categorical dimensions *do* play a causal role (2005b, p. 470), albeit a passive one. They are 'factors' in the causal process and, as circumstances for the operation of causal powers, feature in the laws of action that describe these powers.

This causal role, while allowing room for structural properties to be recognised by virtue of their relationship with causal powers, problematises the claim for categorical dimensions being purely quiddistic. As 'pure forms of physical structure', they have been described as restricting, constraining and informing the kinds of effects that causal powers can wield (Ellis, 2002, p. 174). Yet Ellis denies that they produce any effect that can be attributed to their own action. They do not 'resist, deflect or otherwise interfere with the actions of any known causal powers' (2010). While determining where causal powers may exist and how they are distributed (2010), they do so not as causal powers or, if my earlier argument holds, even by being dimensions *per se*; but by sheer dint of existing 'structurally'.

They purportedly fulfil their causal roles without acting, but this raises the question of how we might know about properties that are deemed to *do* nothing. How might their effect-contribution, including their ability to affect our perception of them, be achieved? Ellis explains that we can know about these entities, not by virtue of their own abilities, but because of the abilities and actions of the relevant causal powers. He claims that 'the physical causal powers always act to change the values of the dimensions of the things on which they act' (2008a), suggesting that the fundamental categorical properties might be discerned because they are respects in which things can change, and that this discernment is achieved by virtue of the causal powers of the objects that possess these categorical dimensions. Ellis notes:

> Spatial properties, such as shape and size, are known to us because things of different shape or size affect us differentially. They produce in us different patterns of sensory stimulation, so that things of different shape and size look or feel different… But if spatial, temporal, and other primary properties and relationships are not causal powers, the question arises as to how we can know about them. We can know about them, we say, because of the dependence of the quantitative laws of action of the causal powers on these relationships. If the laws of action of the causal powers were independent of such factors as size, shape, direction, duration, spatio-temporal separation, and the like, then we could never know about them (2001b, pp. 136, 138).

In a recent communication, Ellis more explicitly describes and reaffirms how the categorical dimensions are discerned:

> The categorical dimensions of things are made manifest to us, not directly by their own powers, (for they have none), nor by our own innate capacity of perception (for nothing can perceive a quiddity directly), but by the distributed causal power of the things that possess them, and our innate capacity to learn from experience about the shape of this distribution (2008a).

This explanation requires a *relation* between the categorical dimensions and the causal powers of their bearers. In short, things possess categorical dimensions that change in response to the action of causal powers, and these changes are perceived and interpreted by us, allowing us to infer the presence of the categorical dimensions.

This seems to be what Ellis means when he writes, 'For the causal powers that stimulate our senses presumably all have constant laws of action that enable us ultimately to construct accurate neural maps of the locations of their sources, and hence of many of the categorical structures [sic] things that lie within range of our senses' (2008a). The upshot is that, in virtue of the causal role they play as they engage—via laws of action and reaction—with the causal powers, categorical dimensions escape the criticism that they are not discernible.

Earlier, I argued that being a dimension *per se* does not make a property categorical rather than dispositional. However, might being a dimension *per se* render a property powerful rather than categorical? The claim that quiddities can be known because of some causal role, even if passive, seems to raise the question of whether this role is fulfilled, not by virtue of the categorical dimensions being quiddistic, but because structure is powerful. The issue can be formulated in terms of teasing out what a property *is* from what a property *does*.

Let us suppose, as suggested by Ellis, that the role of categorical dimensions is to constrain and direct causal powers by limiting how they themselves can be changed. In this case, how changes can occur, and thus what the causal powers can do, seems 'built-in' to what the dimensions *are*. In this sense, the categorical dimensions are structural, yet play a causal, albeit passive, role. The problem is that the identity of these categorical properties is now determined not completely by what they *are*, but also by what they *do*. In this volume, Ellis suggests that we recognise at least certain categorical properties through common patterns of spatiotemporal relations (2010), where these patterns are recognisable, not because of the categorical properties of the bearers, but because of essential dispositional properties that these bearers also possess. Thanks to these latter properties enacting patterns of behaviour

upon the former, we discern the existence of categorical properties. However, I maintain that the categorical properties have *some* effect if the patterns arise by virtue of their interactive presence; and this appears to render them powerful *in some way*.

If 'quiddity' means what a property *is* over and above its causal role, then it can be argued that no such *pure* form of quiddity exists. However, rather than assuming the relevant property to be therefore dispositional, an alternative—and perhaps better—solution might be to recognise such properties as 'powerful'. Unlike the 'power-qualities' put forward by Charlie Martin and John Heil in their Identity Theory of Properties (Heil, 2003; Martin, 1996, 1997), however, I suggest that power is aligned with neither categoricity nor dispositionality. Properties that are powerful might be best described as those that both *are,* and yet *do,* merely by virtue of being. Although powerful, these may also be described as structural. Such properties are not categorical because they are not purely quiddistic, but I resist viewing them as dispositional because they are ontologically-robust, and hence always manifesting simply by virtue of existing. Molnar proposes that we might allow such properties 'full ontological status on par with all of the paradigms of respectable existences' (Molnar, 2003, p. 141). This requires powers to be more than mere possibilia, since it involves actuality in the sense of ontological-robustness.

3. Location

Ellis has argued that the passive causal role attributed to categorical dimensions as 'factors' in causal processes can be differentiated from the active causal role of causal powers (2010). The difference between categorical properties and causal powers resides in this passive versus active distinction. It is tied to the fact of categorical

properties having their identity in terms of what they *are*, while the identity of causal powers and other dispositional properties is given by what they *do*. However, if we cannot tease out what a property is from what it does, then the distinction between passive and active causal roles is compromised.

The spatiotemporal property of location (assuming it can be considered a property) is paradigmatically categorical for Ellis (2010), and importantly, all causal powers are located. This is one reason why the laws of action describing causal processes all include categorical dimensions. In this section, I argue that seeing location as categorical depends not so much on the active-passive distinction, but more on whether the property is intrinsic to its object-bearer or represents an extrinsic relation between objects. (In this discussion, the arguments for relations between objects also apply to relations between mereological parts of complex objects). Ellis argues that all genuine dispositional properties are intrinsic to an object and necessarily extant in all instances of that kind. All acids, for example, have the ability to supply protons in a chemical reaction, just as all electrons have a negative charge (Ellis, 2002, pp. 77-78).

The term 'location' is encompassed by the more general idea of spatiotemporal relations. Distance, for example, describes the location of one object with respect to another in terms of spatial separation. Location can also relate an object and a spacetime point within a frame of reference; even an absolute frame of reference, such as in the example cited by Ellis whereby a location, if emptied of all causal powers, would still be a location. Ellis notes that all instances of causal powers have specific locations, which are had contingently. He supplies the example of specific instances of gravitational mass (2010). Objects are located here or there, but might have been located otherwise, or subsequently change their location through

time. Thus the property of gravitational mass, although essential and intrinsic to those objects possessing it, is borne by objects that are nonetheless located contingently with respect to some spacetime frame of reference. By contrast, instances of location are said by Ellis to be necessarily where they are.

Location might be conferred with meaning in terms of the relation between an object and an absolute spacetime through which the metric for a fixed 'background' structure is presupposed (Kribs & Markopoulou, 2005, p. 4). Alternatively, from a relationalist perspective, location has meaning only with reference to physical entities. On one hand, if location is derived via reference to a fixed background, then as Alexander Bird (2005; 2007, pp. 161-168) and Stephen Mumford suggest (2004, p. 188), this may constitute merely a choice of theoretical perspective. According to General Relativity, spacetime is not absolute, while various theoretical models in physics and in metaphysics treat spacetime as emergent (Bilson-Thompson et al., 2009; Bilson-Thompson et al., 2007; Harré, 1970; Harré & Madden, 1975; Smolin, 1997, 2000, 2006). On the other hand, if location is derived only with respect to the contents of the universe, then in keeping with the contingency of objects' locations, instances of location in general should also be deemed contingent. Moreover, even if it were hypothetically possible to remove all causal powers from a certain spacetime region, as Ellis suggests, the location itself would nonetheless be derived or 'framed' in relation to neighbouring objects.

Ellis attempts to base the categoricity of location on a contrast between the necessity of location instances and the contingency of causal power instances. The above argument amounts to proposing that this contrast only holds for theories that adopt a fixed spacetime background. I also earlier commented on why an active versus passive distinction between causal powers and categorical dimensions is

unpersuasive. However, there is another option for an ontology that allows distinct objects to exist. This is to distinguish between Ellis's causal powers and categorical dimensions based upon whether the property or relation is intrinsic or extrinsic.[1] I suggest that a more suitable criterion for location—and indeed, any spatiotemporal relation—being categorical, in Ellis's theory, is its being merely contingent in the operation of causal powers; and being contingent, I suggest, properly corresponds to its being extrinsic to the bearer of those causal powers. Taking distance, for example, Ellis argues that its being a factor in the outcome of a causal process—e.g. 'living a long way from Sydney prevents one from walking there'—does not itself constitute a causal power. We may think of causal powers in terms of dispositional properties, the possession of which bestows upon their bearers the ability to act in certain ways depending on the essential nature of these properties. Then distance does not bestow any *particular* ability (or in this case disability) upon the walker. Given that it features in many other causal laws, it is not an essential property or causal power intrinsic to the walker. Rather, since distance is extrinsic to the walker, it is a non-essential, categorical property, only contingently related to the walker. Nonetheless, it features in the law in question, playing a role in conjunction with other more specific powers that *are* intrinsic to the walker, such as endurance, muscular power and cardiovascular conditioning. Similarly, in the case of the weight example mentioned earlier; its *location* with respect to other objects contributes to the circumstances within which its causal powers operate, and which contribute to the laws of action of those powers. However, because its location is given with respect to other objects that are external to the weight itself, this cannot be an essential property of the weight, and hence cannot be a causal power of the weight. It must, instead, be a contingent, categorical factor that features in the laws of action specifying the effect of the weight.

Ellis defines a causal power as follows: 'Any quantitative property P that disposes its bearer S in certain circumstances C_0 to participate in a physical causal process, which has the effect $E - E_0$ in the circumstances C_0, where E is the actual outcome and E_0 is what the outcome would have been if P had not been operating' (2010). A physical causal process is defined by Ellis to be an energy transfer from the state of one physical system to another, so as to bring about a physical change in the system that would not have occurred in the absence of that physical causal process (2010). This description outlines two criteria for being a causal power: It must dispose its bearers to be involved in causal processes that i) involve transfer of energy; and ii) would thereby make a difference in outcome so long as the circumstances remain constant. (A causal process builds-in the idea that energy transfer occurs between states of different systems, although I see this as including energy transfer between different states of sub-systems of complex systems.)

Applying this description of causal power to the Sydney example: *Living a long way from Sydney disposes me, in certain circumstances, to not walk to Sydney, which alters the outcome of whether or not I go there.* No transfer of energy takes place, either actually or counterfactually, and so 'living a long way from Sydney', i.e. distance from Sydney, is not a causal power. But this example is complicated by being phrased negatively. Here is a parallel, but positive example: *Living close to a dairy disposes me to buy milk there rather than go without milk.* Here, energy is transferred in the process of walking to the dairy and bringing milk home. A physical change occurs, fulfilling one requirement for my location to be a causal power. The second requirement is that the presence or absence of closeness makes a difference to the outcome. Were I living further from the dairy, I would have no milk. So this criterion for distance being a causal power is also met.

According to the definition of a causal power, therefore, it is not clear from this example alone why distance should be treated as a *factor* or *circumstance* in my having milk rather than as a *causal power*. The reason could be that choosing to buy milk is typically seen as a contingent matter, even with the relevant circumstances in place. The supposed contingency is tied to the scenario whereby myself, my home, the dairy and the milk are all counted as distinct objects rather than constituting a single system. My buying milk is accordingly considered contingent by the Humean Principle of Independence, which disallows necessary relations between distinct objects (see, Armstrong, 2000, p. 8). Causal powers, however, do not represent contingency in this way. The power to crush an object under a weight, for example, would operate necessarily, providing that the circumstances specified in the laws of action of that power were in place. (I am putting aside probabilistic causal powers or propensities for the purpose of this example.) Thus, the claim that distance is merely a factor rather than a causal power depends on whether the separation between objects is viewed as extrinsic and contingent or as intrinsic and essential.

How might we observe distance as intrinsic rather than extrinsic? Suppose Mars and Venus were 50 million miles apart. The two masses could be counted as causal powers with specific locations (possibly identifiable with particular singularities in the gravitational field). But if the situation is viewed from a field-theoretical perspective, taking into account the entire region's contours of gravitational potential, then all the field contours throughout the 50 million-mile region are directly involved in how the whole set of field contours will behave—and this is the only relevant behavior that will take place. Given any contingent variation in the local field contours, such as constituted by the presence of Earth, for instance, the field contours of the entire region would then behave differently. In fact, given the

field topology at any time, and its subsequent behaviour, we could retro-determine the distance between Mars and Venus. (The topology and behaviour of the topology need not explicitly incorporate distance). This perspective implies that the relevant causal power (in this case gravitational power) is not really *at* any particularised location—but exists everywhere throughout the region of interest. At any time, any difference in the field contours of the whole region would cause different behaviour, and since distance is an intrinsic aspect of the field contours, it thus corresponds to causal power. Clearly, the distance could be retro-determined in various ways—in terms of other causal powers and laws—which might be taken by some theorists[2] to suggest its ontic independence. For example, the distance between any two charges could be retro-determined from the topology of the electromagnetic field at a given time, along with that field's subsequent behaviour. (Naturally, at this scale, the scenario is extraordinarily complicated by the phenomena of quantisation.) Both gravitational and electromagnetic scenarios will determine the same distance, but this simply indicates an intrinsically deep connection between the scenarios. It highlights that the singularities of gravitational fields could simultaneously be the singularities of electromagnetic fields. (Of course, it is commonly, if optimistically, anticipated that a unification of all the fundamental forces will be discovered.)

Perhaps being an extrinsic, contingent relation between distinct objects or states, versus being an intrinsic, essential property, amounts to the difference between what is deemed a categorical dimension and what constitutes a causal power. If so, then the difference is theory-bound rather than ontologically-robust. Say, for example, my home, the dairy and the land stretching between them are viewed as part of the same, very complex system rather than as distinct objects. In this case, just as in the

[2] This was a point made to me by Brian Ellis in personal communication.

Mars-Venus case, distance (as 'size') is an intrinsic property. Likewise, the weight, the wire and the object situated for compression by the weight may all be considered a single system to which the distance between the weight and object is intrinsic and essential.

4. Consequences

In a possible world containing just a single system—such as a field-theoretic view—extrinsicality, and hence contingency, is removed. An ontology that builds-in distinct objects requires contingency in the relations between such objects; ontologies that deny distinctness between parts have no need of categorical properties to supply contingency in the form of extrinsic relations between parts. The cost for this latter Foundation-Monist view, which I endorse, is that ontologically-robust possibility must also be denied. I think that denying categorical properties is defensible providing that possibility is accepted as merely an epistemological abstraction, which can be formulated in various ways. Taking a 4-dimensional block universe (4-D) perspective, for example, the intersections of object world-lines represent interactions. At any given time slice, the possibility of two world-lines intersecting is defined by the conjunction of their respective 'future light cones'. The extent to which light cones overlap pertains to the distribution of mass-energy associated with power or potentiality. However, the notion of 'possibility' embedded within our use of counterfactuals is pertinent because we are blind to the future. We do not possess a 'God's-eye point of view' to know 'the end from the beginning' (see: Isaiah 46:10). Observing whether any two world-lines actually intersect, God has no use for possibilities. In a 4-D world-model, possibility arises due to the inability to see time

slices ‘ahead’. In a purely relational universe model, possibility would arise similarly, due to the inability to ‘see’ beyond a certain radius within any relational net. In either case, it is an epistemological abstraction.

Considerations of whether the universe is fundamentally indeterministic, with ontological possibility built-in as randomness, are presently under discussion in physics and philosophy. Issues include whether the probability that features in Quantum Mechanics is subjective or objective, and whether measurement entails irreducible uncertainty (see, Caves et al., 2008). Regardless of these debates, it seems that the *appearance* of possibility can be linked to the emergence of ostensible higher-order categorical properties at the object-level, where contingent relations between objects are called for. It is interesting that categorical properties and relations might actually provide for contingency, and thus for possibility, considering that dispositional properties are traditionally posited as the harbingers of possibility or potentiality.

One reason for distinguishing between dispositional and categorical properties only at the object-level is, as Ellis notes, because this is where causal powers and their bearers exist. By providing the contingent circumstances for the manifestation of causal powers, categorical properties and relations are deemed responsible for accommodating unmanifested dispositional properties. In his paper in this volume, Ellis suggests viewing dispositional properties in two different ways: Unconditional (e.g. ‘propensities’) and conditional (e.g. causal powers) (Ellis, 2010). For Ellis, the propensities are more primitive than the causal powers, and their laws of action are independent of contingent circumstances that involve categorical properties. An example might be a substance that undergoes spontaneous radioactive decay. In contrast, conditional dispositional properties, such as causal powers, rely upon

categorical properties such as location and spatiotemporal relations to provide the circumstances in which their relevant laws of action and reaction operate.

It seems that only conditional dispositional properties, such as the causal powers of objects, require categorical properties for providing the contingency that makes them conditional. Hence there is good reason to suppose that the categorical-dispositional distinction goes hand in hand with accounts of distinct objects. This raises two questions: First, whether ontologies that do not incorporate categorical properties at the fundamental level can build them in at the object-level in order to account for contingency; and second, whether ontologies that accommodate contingency, by positing ontologically-robust categorical properties at the object-level, are constrained to also include them at the fundamental level.

Answering the first question, I think that if ontologically-robust categorical properties are absent at the fundamental level, then the best that can be achieved at higher-levels is to account for categoricity in instrumental terms. One approach is to consider what we really mean by the units of dimensions, say, mass or distance.[3] Certain quantities in fundamental physics can be reduced to dimensionless numbers, dispensing with units altogether. Choice of units such as the second or the metre is often a matter of convenience and to a large extent reflects accepted physical theory. For example, as James Hartle notes, the second is defined as 'the time required for exactly 9,192,631,770 cycles in the transition between the two lowest energy states of a Cesium atom'. Employing the observation that the speed of light is the same in all inertial frames of reference, the metre is then defined as 1/299,792,458 of a second (Hartle, 2003, p. 541). We have separate units for mass, length and time because our prior physical theories used independent standards for these quantities. The metre, for

[3] I wish to thank Brian Ellis for this suggestion.

example, was defined by the distance between two marks on a particular bar, and the second was defined as a certain fraction of the mean solar day. Developments in physical theories, however, have come to show the interdependence of dimensions as measurements change to reflect updated information. As absolute quantities, both the speed of light and Planck's constant are frequently assigned the value of unity. The 'kilogram' has been traditionally defined as 'the mass of the block of metal kept in the Bureau International des Poids et Mesures, in Sèvres' (outside Paris). Today, as Hartle notes, the kilogram can be defined in terms of distance: 'with confidence in the equality of gravitational and inertial mass, general relativity, and access to precise enough measurements, the kilogram could be defined as the mass of a sphere such that a test mass completes a circular orbit of radius 1 m in some defined number of days' (Hartle, 2003, p. 542). As Ellis notes in personal communication (Dec 2009), if it is in principle possible to measure distance, say, in terms of kilograms, then it might be also possible for all quantities to be measured in terms of dispositional ones. If so, then all quantities could be seen as derived dispositionally. This principle can be taken further to suppose that it might be equally convenient (or inconvenient) to measure all quantities categorically, depending on instrumental purposes. This situation reinforces my claim that the categorical-dispositional divide is best viewed as a supervenient, higher-order distinction which, albeit intuitively appealing and instrumentally useful, embodies no ontologically-robust division of reality.

Coming to the second question posed above—should theories that posit ontologically-robust categorical properties, at the object-level, also build them in at the fundamental level? Consistency would seem to demand an even-handed treatment whereby ontologically-robust categorical properties at the object level should derive from something more fundamental. This is the position that I believe applies to New

Essentialism, although it is not clear how such categorical properties might be built-in. They are thought necessary in order to provide an account of structure, but if all categorical properties can be given in terms of dispositional ones, as argued above, then the burden of proof is on the dualist to show why structure should be considered categorical rather than powerful.

One important reason Ellis provides for rejecting the consideration of structure as powerful rather than categorical is couched in the form of a neo-Swinburne regress argument. The Swinburne regress objection is that a purely dispositional world ultimately lacks the resources to allow for the detection of properties and their effects. Richard Swinburne argues that a regress occurs for such worlds: We recognise powers by their effects, which are recognised in terms of the properties they involve. If these properties are themselves nothing but powers, then effects must be recognised by effects which must be recognised by effects, and so on; but at no stage are the required properties encountered. This regress can be broken, submits Swinburne, only if there is something more to properties than powers (1980, p. 317). The idea of structure being categorical is thus driven by calls for the effects of causal processes to be directly observable at some point, for which categorical properties are purported to be necessary; supposedly affording direct perception of effects. Ellis claims that, at some point in the causal chain, changes must occur in 'directly observable dimensions of things' (2008a). In this volume, he further notes that, although causal powers also give us direct knowledge of the world, quiddities 'are among the most direct objects of knowledge that we have of the world' (2010). However, I suggest that almost the opposite seems to happen if, as noted earlier, these are observed only indirectly via patterns of distributed causal powers.

As I have argued, we are: i) not able to tease out what a property is from what it does; ii) not able to directly detect quiddities, which leaves the Swinburne regress unresolved; and iii) on the understanding that certain absolute physical quantities permit re-interpretations of measurement, not able to clearly differentiate between categorical and dispositional quantities. Accordingly, I contend that we should consider the dispositional-categorical distinction to be merely instrumental, and supervenient upon a pure-power world. Resistance to a pure-power ontology seems to come from intuitions that the scientific picture concerning object-hood should mirror the ostensible objects of the manifest world, which would seem to entail fundamental particularity. However, in line with Michael Redhead, Paul Teller, Carlo Rovelli and others, I think that there are good reasons to deny the existence of fundamental particularity.

5. Rejection of Strict Particle-hood

There appears to be a prevalent, natural bias toward positing fundamental categoricity, connected with the intuitively attractive idea of fundamental particularity (i.e. haecceity or primitive thisness). Particles have traditionally involved 'primitive thisness' (Teller, 1995, p. 29) or haecceity—described by Armstrong as that which individuates particulars; a unique inner essence over and above any properties (1997, p. 109). Michael Redhead calls this 'transcendental individuality' (TI)—the idea of entities as 'bearers' of properties, or in Redhead's words, 'individuation that transcends the properties of an entity' (1982, p. 59).

The reality of particles in modern physics and more recently in metaphysics is highly debated, with a consensus in favour of abandoning the traditional concept.

Redhead argues that a traditional dualistic approach adopts two categories of entity: particles and forces between them. We may ask whether particles can be reduced to forces, and/or forces to particles. He shows that by quantising a field, we give it a particle aspect. In Quantum Field Theory (QFT), while particles are created and destroyed, they are, as Redhead notes, 'just quantized excitations of particular modes of the field' (p. 70). He likens them to the bumps in an active skipping rope, whereby quantisation does not entail that the field constitutes a collection of traditional particles (p. 70). Redhead provides an extended argument why the distinction between 'field' and 'particle' can be tied to neither the distinction between boson and fermion, nor that between massless and massive fields (pp. 72-76). Photons, for example, have zero rest mass, but because they carry energy and momentum, observes Redhead, we are inclined to treat them as substantial (p. 79). However, he writes, 'it is not at all clear which is the "matter" particle and which is the "force" particle' (p. 80).

Redhead's attempt to address the dilemma involves retaining the concept of particle while questioning the distinction between substance and force. He posits 'ephemerals', described in terms reminiscent of Lewis Carroll's 'Cheshire cat' as 'entities which can be distinguished one from another at any given instant of time, but unlike continuants cannot be reidentified as the same entity in virtue of TI at different times' (p. 88). Since a collection of indistinguishable particles may be described as an ephemeral in Redhead's view, this encompasses fields. He writes, 'like the Cheshire cat, although the substantial particularity has gone, there remains a particle "grin". The elementary "particles" are not particles but they are also not classical-type fields. They are quantum fields - ephemerals with a particle grin' (p. 88). They are not classical fields, in this view, because they retain particle-like aspects such as energy

and charge that come in discrete amounts (Teller, 1982, p. 108). Thus, according to Redhead, the 'particle' and 'field' concepts are underdetermined in QFT.

Paul Teller adopts Redhead as a starting point, but takes his 'too soft treatment of ephemeral particles' further, to abandon any role for particularity. Teller claims that the notion of 'particle' in QFT is a relic of overlooking the fact that a full description, as per Feynman diagrams,[4] must depict superposition of *all* processes mediating between input and output. Partial or selective use renders the appearance of such diagrams as operating in terms of the particle concept to the exclusion of the superimposable field concept (Teller, 1982, p. 109).

The argument for abandoning particles involves rejecting haecceity, or in Teller's preferred terminology, primitive thisness. He describes a hypothetical scenario whereby distinct particles (say, an electron and a proton) are distinguished by fixed, individuating properties. Teller argues that although it is 'natural' to read these fixed properties in terms of primitive thisness, attempts to formalise such a reading[5] lead to 'surplus structure', a term employed by Redhead (1975, p. 88) to formally describe elements that are absent in the 'real world' (Teller, 1995, p. 25). That is, recognition of fixed properties will entail system components (e.g. non-symmetric vectors) that lack real-world counterparts (pp. 20-26). This failure of reduction from theory to the natural world is argued by Redhead to show that elementary particularity in the traditional qualitative sense does not exist. It represents what he calls 'one of the most profound revisions in our ultimate metaphysical *weltanschauung*, that has been engendered by our most fundamental physical theory, viz. quantum mechanics' (pp. 61-62).

[4] A Feynman diagram symbolically represents sub-atomic 'particle' interactions according to all possible 'pathways'.
[5] For example, by using Labeled Tensor Product Hilbert Space Formalism (LTPHSF).

Carlo Rovelli views particle-hood as a long-standing inference formulated in spite of the fact that the particle-aspect of these quantum 'entities' has never been detected and might be undetectable in principle (1997, p. 191). For Rovelli, particle-hood as traditionally conceived appears unsustainable:

> Indeed, a physical particle cannot be an extended rigid object, because rigid bodies are not admitted in the theory (they transmit information faster than light), nor can it be a pointlike massive object, because such objects too are incompatible with the theory (they disappear in their own black hole). Thus, understanding the physical picture of reality offered by general relativity in terms of particles moving on a curved geometry is misleading (1997, pp. 191-192).

As Rovelli explains, fundamental particles could not be rigid bodies involving instantaneous transmission of effects from one side to the other, faster-than-light processes being ruled out by Special Relativity. Explicitly, the spacetime interval $Q^2 = c^2\Delta t^2 - \Delta s^2$ must be zero or positive for all physical processes. Thus, you cannot accommodate extension through space without sufficient accompanying extension through time, and any continuous, purely spatial extension is untenable (putting aside discussion of tachyons or pseudo-processes). Neither could particles be point-like: Given $F = Gm_1m_2/r^2$; particles with zero radius would form 'singularities' of infinite gravitational force, causally cut off from the universe.

John Gribbin argues that the 'folk notion' of fundamental particles is basically a means to understand the mathematical laws describing fields of force, spacetime curvature and quantum uncertainty (1998, pp. 51-52). Hence, electrons may be

interpreted as ‘energetic bits of the field’ confined to a certain region (Gribbin, 1998, p. 61) in accord with an application of Heisenberg’s uncertainty principle relating energy and time. An energy variation multiplied by an associated time variation must be less than or equal to Planck’s constant—determining the size of the quanta characterising field fluctuations. It is plausible that current physics theories will show that electrons, quarks and other candidates for fundamental particles can be properly understood solely in terms of underlying fields or microstructural topological arrangements of pre-space fundamentals that do not persist in the manner described of categorical entities or properties. It is feasible, therefore, to suppose that just as electrons, legitimately interpreted as charged regions of virtual photons, might boil down to manifestations of the field, so the categorical-dispositional distinction might be merely a higher-order distinction that is supervenient upon a pure-power base.

6. Summary and Conclusion

I have argued that the claim for categorical properties underpinning spacetime structure is not linked to their being dimensions; but rather, by virtue of their being quiddities. However, it is not clear that what these properties *are* can be teased out from what they *do*, compromising their status as quiddistic, where this means having identity by virtue of something over and above causal roles. The conflation of a property’s *doing* with *being* also blurs the distinction between categorical dimensions as passive factors and causal powers as active drivers of causal processes.

Instead, the distinction between categorical dimensions and causal powers might be better understood in other terms; the former being extrinsic and contingent with respect to objects bearing causal powers, and the latter being intrinsic and

essential properties of their bearers. Formulated in these terms, the distinction relies upon notions of intrinsicality and extrinsicality, which in turn presuppose the reality of distinct objects. I have suggested that this is why the categorical-dispositional distinction appears to arise at the object level.

Consistency would seem to demand that if such a distinction were ontologically-robust, heralding a real difference among types of properties, then it should obtain at fundamental levels, entailing fundamental categorical properties and, in turn, fundamental particularity. However, currently prominent theories of physics and some metaphysics seriously question the reality of fundamental particularity. Moreover, I have argued that location and other spatiotemporal relations must always be given either with respect to some fixed spacetime structure or by reference to the contents of the universe. The first way requires a background dependent ontology, the existence of which is under considerable doubt in modern physics and metaphysics. The second way should, I propose, treat location in the same manner as the objects in relation to which it is derived—as existing contingently. If this argument holds, then no real distinction can be drawn between location and causal power, based solely upon instances of causal power being contingent and instances of location being necessary.

I have also claimed that the consistent denial of fundamental categorical properties requires the categorical-dispositional distinction, at higher-levels, to be merely instrumental and supervenient. This assertion is strengthened by noting that physics allows for conversion between measures of what have been seen as categorical quantities (e.g. distance) and dispositional ones (e.g. mass). The single-system approach of a Foundation-Monist theory requires no fundamental categorical

properties. Such an ontology is consistent with a merely instrumental categorical-dispositional distinction rather than a reality divided into two types of property.

However, denying the ontologically-robust existence of categorical properties does not entail that all properties are dispositional. I point out a difference between what have been called dispositional properties and those that can be described as powerful in terms of ontologically-robust transmissions of effect. These properties can also be described as structural; they both *are* and *do*; but I do not view such pure-power properties as categorical, since they are not purely quiddistic.

I have tried to show that the distinction between categorical and dispositional properties is theory-bound rather than depicting an actual division into types of property. The cost of proposing a pure-power ontology is that an absence of contingency requires it to reduce the notion of possibility to an epistemological abstraction. This fee seems affordable compared to the inconvenience of incurring fundamental particularity. The benefits include being able to explain what intuitively appears to be a world comprised of fundamentally powerful structure. In contrast, dualist theories that build-in distinct objects, and therefore fundamental particularity, face problems in justifying the distinction between what have been considered to be categorical and dispositional properties, especially in light of modern developments in physics. Such a distinction renders structure purely quiddistic, but such quiddity would appear to be powerful merely by dint of existing. Accordingly, perhaps the distinction between categorical and dispositional properties should be re-evaluated in terms of a fresh notion of pure-power.

The push in physics is to find a unified theory integrating power and form. Whatever eventuates, current physical theories seem to herald a profound revision of spacetime, including location and other spatiotemporal properties and relations, in

favour of these being emergent from something more fundamental, and conceivably purely powerful. I conclude that there is room for legitimate metaphysical scepticism concerning the existence of fundamental categorical properties, and concerning ontologically-robust distinctions that are predicated upon assuming the reality of distinct objects and fundamental particularity.

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[1] The concept of 'intrinsic' or 'intrinsicness' has been the focus of considerable debate in philosophical literature over the last three decades. In 1983 David Lewis separated the notions of 'intrinsic' and 'internal' on the basis that some properties can be only partially intrinsic. These include, for example, being a brother, being in debt, or being located with respect to some place. According to Lewis, properties that are entirely intrinsic (e.g. shape, charge or internal structure), are internal (Lewis, 1983a, p. 197). This definition has been much discussed in papers on intrinsicness, with calls for a more precise delineation of properties and relations of objects that are co-relational with other objects. The formulation of the term 'intrinsic' that I use in this paper is primarily aligned with that provided by Robert Francescotti's formal definition, given as follows:

> F is an intrinsic property = df necessarily, for any item x, if x has F, then there are internal properties I1,..., In had by x, such that x's having F consists in x's having I1,..., In . (Call a property that is not a d-relational feature of item x an internal property of x.) (Francescotti, 1999, p. 608).

George Molnar also gives an insightful definition of what it means to be intrinsic: 'intrinsic properties are those the having of which by an object in no way depends on what other objects exist' (p. 39). Stated by him more formally, '*P* is intrinsic to *x* iff *x*'s having *P*, and *x*'s lacking *P*, are independent of the existence, and the non-existence, of any contingent object wholly distinct from *x*' (p. 102). The definition of intrinsicness that I will use in this paper incorporates key concepts that are central to all of these definitions: an intrinsic property is one possessed by an object which is, itself, not *d*-relational to any other distinct object. That is to say, as Molnar explains, an intrinsic property is had by an object independently of the existence of any other object. The terms '*d*-relational' (i.e. relational to any distinct object) and 'independent from', in the above, are similar conceptually to Langton and Lewis's use of the term 'unaccompanied' or 'lonely' to discuss objects not contingently co-existing with other (distinct) objects (1998, p. 343).[1] Adopting a compatible view of relations, I will use the term 'intrinsic relations' to refer to relations between properties of unaccompanied objects, providing that these relations may never differ between duplicate pairs (i.e. pairs that have all of their internal properties the same). It follows that properties and relations that are not entirely intrinsic are in some degree external to their relata.