

MaxCon extended simples and the dispositionalist ontology of laws

Travis Dumsday¹

Received: 14 January 2015 / Accepted: 29 December 2015 / Published online: 16 January 2016
© Springer Science+Business Media Dordrecht 2016

Abstract Extended simples are physical objects that, while spatially extended, possess no actual proper parts. The theory that physical reality bottoms out at extended simples is one of the principal competing views concerning the fundamental composition of matter, the others being atomism and the theory of gunk. Among advocates of extended simples, Markosian’s ‘MaxCon’ version of the theory (Aust J Philos 76:213–226, 1998, Monist 87:405–428, 2004) has justly achieved particular prominence. On the assumption of causal realism (i.e., on the assumption that a Humean account of causation is false), I argue here that the reality of MaxCon simples would entail the reality of irreducible, intrinsic dispositional properties. The existence of dispositional properties in turn has important implications for another central debate in metaphysics, namely that between two major competing views concerning the ontology of laws: dispositionalism versus nomological necessitarianism.

Keywords Dispositions · Laws · Simples · Metaphysics · Ontology

1 Introduction

The three most commonly defended theories concerning the fundamental composition of matter are: (1) *atomism*, the notion that nature bottoms out in indivisible, unextended objects; (2) the theory of *gunk*, according to which all material objects have actual proper parts (i.e., each object is composed of proper parts that are themselves objects composed of proper parts that are themselves objects composed of proper parts, etc. ad

✉ Travis Dumsday
travis.dumsday@concordia.ab.ca

¹ Department of Philosophy & Religious Studies, Concordia University of Edmonton, 7128 Ada Blvd., Edmonton, AB T5B 4E4, Canada

infinitem); and (3) the theory of *extended simples*, which is the idea that the splitting process eventually reaches objects that, while still spatially extended and still divisible (in a sense—more on that shortly) lack actual proper parts; i.e., extended simples are not composed of real, smaller objects.

These three theories are prominent historically¹ and possess advocates in the current literature.² Powerful arguments exist for and against each, and I cannot review here the current state of debate. My aim is to show that the theory of extended simples has an important but neglected implication concerning another central debate in metaphysics: that between the three principal theories concerning the ontology of laws.

Those principal theories (or rather *types* of theory, as there are variant versions of each) are: (1) *regularity theory*, on which the only irreducible intrinsic properties³ possessed by physical objects are categorical⁴ in nature, laws are purely descriptive of natural regularities, and those regularities have no further ontological explanation or grounding; (2) *nomological necessitarianism*, the advocates of which affirm that the only irreducible intrinsic properties possessed by physical objects are categorical in nature, and that laws are robustly real and prescriptive of natural regularities rather than merely descriptive of them; and (3) *dispositionalism*, the theory that some or all of the intrinsic properties possessed by objects are dispositional in nature,⁵ and that

¹ For historical background, see especially Holden (2004) and Pasnau (2011), pp. 279–299 and pp. 606–632.

² Regarding the contemporary scene, there appears to be some ambiguity. One *might* argue that atomism is widely held, having the status of something like a default position; this seems particularly true for those who work in philosophy of mind, where, as Schaffer (2003) and Nagasawa (2012) observe, the claim that nature bottoms out in fundamental material objects is an important background assumption in reductionist ontologies of the mental. However, while it is true that there are many advocates of the idea that there must be a fundamental layer to the material world, oftentimes these authors do not specify whether they think that material fundamentality entails atomism or whether a bottom layer of extended simples would suffice to fulfill the explanatory role of a ‘fundamental’ level. Sometimes treatments of fundamentality acknowledge the ambiguity between atoms and extended simples, as in Newman (2013). Authors who *unambiguously* defend atomism are in fact relatively few in the recent literature, though atomism does have unambiguous opponents, like Giberman (2012). By contrast, the gunky view has been the topic of a number of sympathetic treatments: see for instance Forrest (2004), Schaffer (2003), Sider (1993), and Zimmerman (1996a, b). Favourable discussions of extended simples include Braddon-Mitchell and Miller (2006), Markosian (1998, 2004), McDaniel (2007, 2009), Parsons (2000), Scala (2002), Sider (2007), Simons (2004), and Toner (2008, 2011).

³ For present purposes ‘properties’ can be taken as neutral between universals and tropes, although all nomological necessitarians and most dispositionalists are realists (whether moderate or Platonic) about universals.

⁴ Categorical properties are typically thought of as *non-dispositional*, and include such paradigm cases as shape, size, spatial extension, spatial boundaries, and perhaps qualitative properties like colour (for those who take colour to be an irreducible feature of reality), etc. ‘Categoricalists’ are those who maintain that the only irreducible intrinsic properties found in nature are categorical.

⁵ Dispositions / powers / capacities / abilities (I’ll use these terms as synonyms) are intrinsically causally significant properties whose identity conditions consist (whether wholly or in part) of stimulus and manifestation conditions, along with any *ceteris paribus* clauses. E.g., fragility is an intrinsically causally significant property whose possession by an object determines that it will break when subjected to certain stresses, *ceteris paribus*; mass is an intrinsically causally significant property whose possession by a body determines that it will attract other massive bodies (with a determinate force given a certain distance, along a determinate vector etc.) upon coming into spatial proximity with them, *ceteris paribus*.

some or all laws of nature are descriptive of the natural regularities grounded in the dispositional properties of objects.⁶

As with the debate on material composition, the debate on laws is longstanding and ongoing, with powerful arguments available on each side.⁷ In what follows I argue that a prominent version of the third principal option in the composition debate (the theory of extended simples) would, if true, establish the truth of the third principal option in the laws debate (dispositionalism). More precisely:

Assumption Causation is genuinely real and irreducible (i.e., any sort of regularity theory of causation and causal laws is false).

Premise 1 If MaxCon extended simples exist, then there is a real and irreducible distinction between objects and stuff.

Premise 2 If there is a real and irreducible distinction between objects and stuff, then dispositionalism is true.

Conclusion Therefore, if MaxCon extended simples exist, then dispositionalism is true.

My aim is thus to establish a conditional. A substantially more ambitious paper would then press onward and present an argument that MaxCon extended simples are in fact real, such that dispositionalism is in fact true. By contrast, this paper knows its place and will keep to it. Establishing this conditional will be quite enough work.

It is worth emphasizing two points at the outset. First, the argument is of limited ambition in another respect, insofar as it is intended to settle a dispute *between the two causal realist camps within the laws debate*: nomological necessitarians and dispositionalists. Unfortunately (from my own dispositionalist perspective) my argument has no bearing on regularity theory. As will soon become apparent, the justification for premise 2 rests in part on the idea that a certain state of affairs requires a causal explanation, where ‘causal explanation’ is understood in a realist sense incompatible with Humeanism. It will also make use of the notion of essential properties, which Humeans also typically oppose. As such my argument will have no purchase on the regularity theorist, since any attempt to use it in that fashion would simply beg the question concerning the larger debate over causal realism.⁸ Second, the argument

⁶ Most dispositionalists would drop the ‘some or all laws of nature are descriptive...’ in favour of a straight-out ‘all.’ However, [Dummsday \(2013\)](#) argues that dispositionalism entails a kind of nomic realism, such that dispositionalism is compatible with a certain sort of nomological necessitarianism. I don’t want to get into that intra-dispositionalist debate here, so I’ll leave the formulation neutral.

⁷ For defences of regularity theory see for instance [Barker \(2013\)](#), [Beebe \(2011\)](#), [Lewis \(1986\)](#), and [Smart \(2013\)](#); advocates of nomological necessitarianism include [Armstrong \(1983, 1997, 2010\)](#), [Dretske \(1977\)](#), [Fales \(1990\)](#), [Foster \(2004\)](#), [Latham \(2011\)](#), [Maudlin \(2007\)](#), [Psillos \(2006, 2009\)](#), and [Tooley \(1977, 1987\)](#); for dispositionalism see for instance [Bauer \(2012, 2013\)](#), [Bird \(2007\)](#), [Chakravarty \(2007\)](#), [Ellis \(2001, 2002, 2009\)](#), [Heil \(2003, 2005\)](#), [Jacobs \(2010, 2011\)](#), [McKittrick \(2003\)](#), [Mumford \(1998, 2004\)](#), [Oderberg \(2007\)](#), [Thompson \(1988\)](#), and [Tugby \(2013\)](#). Note that some ontologies of law, such as [Lange’s \(2004, 2009a, 2009b\)](#) arguably do not fit neatly into any of these three main types of theory (though [Lange’s](#) seems closest to nomological necessitarianism—certainly he explicitly rejects regularity theory and dispositionalism).

⁸ It is an interesting further question whether a Humean could accept the reality of MaxCon extended simples. I think she could, though I will not delve into this here. My thanks to an anonymous referee for emphasizing the need to clarify the relationship my argument bears to regularity theory.

draws specifically on Markosian's account of extended simples. As with atomism and the theory of gunk, variant versions of the theory of extended simples exist (positing somewhat different features for extended simples), but Markosian's is among the most thoroughly developed in the current literature, and (as will be seen) its import for dispositionalism is demonstrable. So by 'extended simples' in the argument laid out above (and developed and defended below) I refer specifically to Markosian's 'MaxCon' simples.

The remainder of the paper is structured as follows: in the next section I review Markosian's (1998, 2004) theory, devoting particular attention to his argument that extended simples entail a real and irreducible distinction between 'objects' and 'stuff.' This section is intended to justify premise 1. In the succeeding section I attempt to establish premise 2, drawing out the connection between the reality of stuff and the reality of dispositions. I conclude with a short recap and reflection on directions for future work.

2 The connection between extended simples and stuff

Markosian aims to answer what he calls 'the simple question': what are the necessary and jointly sufficient conditions for a physical object's being a simple? Or, phrased differently, "Under what circumstances is it true of some object that it has no proper parts?" (1998, p. 214) The answer he comes up with is the 'maximally continuous view of simples,' or MaxCon: necessarily, x is simple iff x is a maximally continuous object. And what is a maximally continuous object? " x is a *maximally continuous object* = df x is a spatially continuous object and there is no continuous region of space, R , such that (i) the region occupied by x is a proper subset of R , and (ii) every point in R falls within some object or other." (1998, p. 221) So a physical object is simple if and only if it is completely continuous spatially (having no proper parts that are spatially separate from one another) and the spatial region it occupies does *not* overlap with the region occupied by any other physical object. Markosian's formulation is meant to capture an important intuition about proper parts and how those parts relate to a whole: "The intuitive idea behind MaxCon is that whenever an object has proper parts, those proper parts are spatially separated from one another. Composite objects, on this view, are all scattered objects (although it is consistent with the view that the different parts of a composite object tend to be not so widely scattered).⁹ But simples, according to MaxCon, are utterly unscattered—and it is in virtue of being completely connected, as opposed to being scattered, that they have no proper parts." (2004, p. 405) This has the important implication that a physical simple can be spatially extended—indeed, in principle there could be very large MaxCon simples. This goes very much against the atomist view according to which a physical simple would have to be wholly unextended, occupying no spatial region.

Note that Markosian's concern isn't to show that MaxCon simples are real; he does want to show that they are possible and that they are the only sorts of things that could actually count as simples (he thinks atomism faces serious problems on this score),

⁹ Note Markosian's assumption that any actual proper parts of an object must themselves be objects.

but he is inclined to think that gunk is also possible. Markosian is thus something of a pluralist regarding the ontology of material objects.¹⁰

Of course, the MaxCon model of simples is subject to various objections. The first Markosian takes up is the old argument that being extended implies having spatially distinguishable sections, which in turn implies having distinct actual proper parts. And having proper parts is inconsistent with being simple. He makes several replies to this objection. One is to point out that if the objection is sound, then the Doctrine of Arbitrary Undetached Parts (DAUP) holds true. DAUP is the idea that any sub-region of a region occupied by a material object is itself occupied by a distinct material object.¹¹ So the region occupied by the middle three centimetres of my femur contains a distinct material object (i.e., distinct from me, and also distinct from my femur, if it too constitutes an object). So does the middle centimetre, the middle centimetre and 2/10 of a centimetre, etc. ad infinitum. But many see this multiplication of objects as counter-intuitive.

As an additional reply, Markosian distinguishes between different kinds of ‘part.’ *Metaphysical parts* are actual proper parts, objects in their own right which come together to compose a larger object. By contrast, *conceptual parts* may or may not be actual proper parts, as they are just the sub-regions of the region occupied by the real object (plus the matter contained in those sub-regions). A genuinely simple object can have conceptual parts, but not metaphysical parts. And that is the situation with MaxCon simples.

It is in response to a further objection that Markosian introduces the object vs. stuff distinction. MaxCon simples could in theory be any sort of shape or size. So a statue of Tim Tebow¹² could be a MaxCon simple, being continuous and possessed of no spatially disconnected parts. Now imagine that the statue is manipulated such that its right arm moves but the rest stays stationary. Doesn’t this entail that the right arm is a really distinct proper part vis a vis the rest of the statue? Not necessarily. An alternative way of conceptualizing the situation is available, whereby “talk about the motion of the arm of the statue can be translated into talk about the motion of the matter that fills the arm-shaped sub-region of the region occupied by the statue at any given time relative to the matter that fills the remaining sub-region of the region occupied by the statue at that time, in a way that does not commit us to saying that there are two objects involved in the case, one in motion relative to the other.” (1998, p. 224) For this reply to work, Markosian recognizes that he needs a real and irreducible distinction between objects and the matter, or ‘stuff,’ that constitutes those objects (irreducible because we are talking about simples here). Without this distinction in place, the arm would have to be regarded as a distinct object, as would any part of the statue that is capable

¹⁰ McDaniel (2007, 2009) follows Markosian in this pluralism; by contrast, Simons (2004) argues not merely for the possibility of extended simples but for their reality and indeed necessity, in the sense that matter is real but atoms and gunk are impossible, leaving extended simples as the only option.

¹¹ Markosian provides a more formal definition (1998, p. 223), derived from van Inwagen (1981, p. 123): “For every material object M, if R is the region of space occupied by M at time t, and if sub-R is any occupiable sub-region of R whatever, there exists a material object that occupies the region sub-R at t.”

¹² I take the liberty of updating Markosian’s statue of Joe Montana.

of being moved without the rest of the statue moving along with it. But that would in turn imply the truth of DAUP, with all its counter-intuitive consequences.

What about a situation where two MaxCon simples become conjoined, forming one larger spatially continuous object? In this situation Markosian says that the two former objects cease to exist, and a new object, a larger MaxCon simple, takes their place. Does this imply a sort of creation out of nothing, with something utterly new popping into existence? Thanks to the real distinction between an object and its constituent stuff, this need not be affirmed. True, a new object comes into existence, but it comes into existence out of the stuff of the previous objects, all of which stuff continues to exist just as it did before. Similarly, if a MaxCon simple is split apart, then what were formerly conceptual parts (spatially distinct stuff-filled sub-regions) become objects. New *objects* come into existence, but the same old *stuff* remains, just occupying two (or more) objects rather than one.¹³

Markosian (1998) provides further arguments for the possibility of MaxCon simples, and replies to further objections, which, in the interests of space, I must pass over here. However I should make some additional points concerning the nature of objects and stuff, which Markosian develops in his (2004). I will focus on what will prove relevant to the link with dispositionalism.

Markosian does not attempt to provide an analysis of ‘object’ or ‘stuff,’ or the relation that links them, taking these to be primitives. Still, they are primitives that we are familiar with in our everyday concepts and language (evident in our use of count nouns vs. mass nouns), and their ontology can be clarified. He first relays some arguments in favour of the idea that an object and its stuff are not identical, arguments familiar from the ‘composition is not identity’ literature. For instance, an object and its stuff can possess different modal properties, including diverse persistence conditions. (This was already made evident in the cases above of stuff surviving the destruction and generation of objects.) He also argues that there cannot be stuff without at least one object existing, and that any maximally continuous amount of stuff constitutes a simple object. “I.e., if there is any matter at all, then there must also be at least one object. Moreover, if there is some matter, and that matter occupies a continuous region of space, and it is not the case that that region falls within a larger continuous region that is also filled with matter, then the matter in question constitutes a simple.” (2004, p. 409) This latter point amounts to saying that any bounded (i.e., determinately shaped) portion of stuff that is spatially distinct from other such bounded portions constitutes an object. So while objects and stuff are not identical, they are inseparable—Markosian even goes so far as to consider them mutually supervenient (*ibid.*, p. 414). And an infallible mark of the presence of an object is the presence of stuff, insofar as that stuff is characterized by geometrical/structural categorical

¹³ So do MaxCon simples count as divisible? If by ‘divisible’ one refers to the real possibility that an object might be made to go out of existence by a physical stimulus and be replaced by new objects constituted by the stuff that used to constitute the original object, then yes, MaxCon simples are divisible. But they are *not* divisible in the sense that we often think of composites as being divisible, where composites are divisible because the bonding relations obtaining between their actual proper parts can be eliminated, such that the composite object ceases to exist and all that remains is the objects that formerly composed it. (Note that Simons (2004) holds that extended simples are indivisible. However, because he doesn’t elaborate on what exactly he means by ‘divisible,’ it’s not clear whether he and Markosian disagree.)

properties like determinate spatial extension (and therefore shape/structure/form and other notions entailed by determinate spatial extension) and is set off from other spatially distinct stuff.

The preceding should suffice for the explication and defence of premise 1 of my argument. Let's turn to premise 2.

3 Objects, stuff, and dispositionalism

On one version of categoricism (relatively common in the 1960s and 1970s), the truthmaker for any true disposition-ascription will consist solely of a categorical property or set of categorical properties. Quine (1966, pp. 71–72) for example writes as follows:

Advances in chemistry eventually redeem the solubility idea, but only in terms of a full-blown theory. We come to understand just what there is about the submicroscopic form and composition of a solid that enables water to dissolve it. Thenceforward, solubility can simply be equated to these explanatory traits. When we say of a lump that it would necessarily dissolve if in water, we can be understood as attributing to the lump those supposedly enumerated details of submicroscopic structure—those explanatory traits with which we are imagining solubility to have been newly equated.¹⁴

This sort of point gains part of its force from the fact that solubility (like fragility and some other common examples of dispositions) is multiply realizable (the solubility of sugar in water is not realized in the same way as the solubility of aluminum in sulphuric acid) and not a fundamental property of anything. Dispositions like mass, charge, and spin resist such treatment. Moreover, Quinean-style categoricism is vulnerable to some classic pro-dispositionalist arguments, such as the Aristotelian standby related by Franklin (1986, pp. 62–63):

Consider Democritus' attempt to reduce all properties of things to the shapes and movements of atoms. He proposed to explain the hardness of solids, for example, by the fact that the atoms of solids were hooked and so stuck to one another. In order to make the solid hard, however, the atoms must not only be hooked, but must retain their hooked shape when they come into contact with other atoms. That is, the hardness of the solid depends not only on the shape of its atoms but also on their rigidity. But rigidity is a disposition, namely the disposition to preserve shape when acted on in certain ways.

This example revolves around the need for dispositions to account for the stability of categorical properties, but examples could be multiplied showing that explanatory factors beyond mere categorical properties are needed to explain the behaviour of objects.

This point is now generally admitted by categoricists, or at least by those categoricists who are realists about causation (so again excluding Humean regularity

¹⁴ Besides Quine, see for instance Armstrong (1968), Mackie (1977), McMullin (1978), O'Shaughnessy (1970), and Prior (1982).

theorists from this generalization, in accordance with Assumption). This is why most categoricallists now adopt the view that dispositions are eliminable in favour of categorical properties + laws, which commitment gets us the second principal ontology of laws mentioned earlier, *nomological necessitarianism*. Advocates of this ontology deny that the truthmakers for true disposition-ascriptions need include irreducible intrinsic dispositions. So the bonding of the hook-shaped ‘atoms’ could be accounted for by reference to the relevant shapes and to certain operative external laws of nature, without recourse to intrinsic causal powers.

In the face of this challenge, a number of replies have been pursued by dispositionallists. For instance, there is a good deal of literature that focuses on revealing internal problems faced by the various versions of nomological necessitarianism.¹⁵ Others focus on the idea that dispositionalism is a better fit with certain empirical findings in physics.¹⁶ Still others defend against any form of categoricism by arguing that categorical properties can themselves be dispensed with altogether as fundamental features of the world.¹⁷ Less popular has been the strategy of trying to show that external laws cannot do all the work that dispositions do—and not because external laws are impossible, but simply because there are some facts that *only* intrinsic dispositions could account for. But that is precisely the strategy that becomes available when one reflects on the dispositionalist implications of MaxCon simples.

Let’s begin by laying out the argument (an argument aimed at justifying premise 2 of the overarching argument presented in the Introduction):

Premise 1 If categoricism is true (and dispositionalism false), then nothing can possess irreducible intrinsic dispositional properties.

Premise 2 But stuff (as understood in Markosian’s theory of MaxCon simples) is possessed of at least one irreducible intrinsic dispositional property: the capacity to take on new shapes.

Conclusion Therefore categoricism is false (and dispositionalism true).

Premise 1 is a basic commitment of categoricism, as noted earlier. According to categoricallists, the only real, irreducible sorts of property in existence are categorical; there are no intrinsic, irreducible causal powers.

Premise 2 is the controversial premise. To justify it, it is necessary to show that the capacity of stuff to acquire new shape is not a capacity that can be reduced to stuff’s categorical properties, nor reduced to its categorical properties + an extrinsic governing law or laws (the standard categoricallist strategies for reducing dispositions), but rather that this capacity is an irreducible intrinsic property possessed by stuff.

To that end: we have already seen Markosian’s view that MaxCon simples can take on a variety of shapes and even sizes. Correspondingly, stuff (that from which a Max-Con simple is composed) can take on a variety of shapes. Given this openness to a range of different shapes, clearly no determinate, specific shape (rotundity or triangularity or whatnot) is essential to stuff. Yet though no specific shape is possessed essentially by stuff, for Markosian stuff can only exist *qua* shaped / bounded in such a way that

¹⁵ See Bird (2006), Handfield (2005), and Mumford (2004) for some examples of this strategy at work.

¹⁶ See for instance Balashov (2002).

¹⁷ See Bird (2007), Bostock (2008) and Coleman (2010).

it constitutes a MaxCon simple (or a continuous portion of a larger MaxCon simple). Stuff and object are inseparable (indeed he goes so far as to say they are mutually supervenient), which entails that stuff must always come shaped. No *particular* shape is essential to stuff, but it is essential that stuff have *some shape or other*. But how is this fact about stuff to be explained by the categoricist?

There are two obvious categoricist explanations:

(A) *The fact that stuff must come shaped, but has no specific shape essentially, is explained by the application of an extrinsic law or laws to stuff. Laws make stuff essentially shaped.* This clearly won't work. If something is essentially x , then it is not x solely by virtue of external intervention (some distinct object acting upon it to grant it x). In other words, if it is part of something's very identity conditions that it be x , then nothing else can give it x ; in order for a law (or anything else) to interact with something, that something must first exist, and *ipso facto* must exist with all its identity conditions in place. Extrinsic laws therefore cannot bestow essential traits. (For example, if an electron possesses negative charge essentially, then nothing distinct from it gives it negative charge). But for Markosian, stuff's being some shape or other is essential to it. Therefore that feature of stuff cannot be bestowed on it by extrinsic laws.¹⁸ And indeed, the categoricist had better hope this is true; after all, imagine a state of affairs in which stuff was not essentially shaped, but rather acquired shape via the application of an external cause governed by a law. That would imply that absent such extrinsic causal intervention, stuff could exist devoid of any shape, and hence devoid of any categorical properties. But the possibility of such a state of affairs would automatically disprove categoricism.¹⁹

¹⁸ Note that this claim needs to be distinguished from a very different proposition: "if something is *necessarily* x , then it is not x solely by virtue of external intervention." There could perhaps be counterexamples to the latter proposition; imagine for instance the case of a necessarily existent, necessarily benevolent Leibnizian deity who in all possible worlds wills that Tim Tebow be a skilled football player. In such a scenario, Tebow would necessarily possess a property, *skill*, but would possess it solely by virtue of an external intervention. (I am borrowing here from Kit Fine's (1994) well-known distinction between essential properties—properties definitive of a thing's or kind's identity—and properties that something possesses by logical necessity but which do not form any part of its identity. The classic example is Socrates and his accompanying singleton set). My thanks to a referee for pointing out the need to clarify this.

¹⁹ In making that last point I am adopting two plausible background assumptions:

- (1) If an entity lacks all categorical properties it must still possess some *other* sort of property, with the only other game in town being dispositions. This further assumes that no entity can exist wholly devoid of properties, wholly characterless. This might be thought to conflict with substratum theory, but for the most part that is not the case, insofar as most substratum theorists maintain that substrata can only exist while instantiating some attribute or set of attributes. [A notable exception on this score is Sider (2006).]
- (2) I am also assuming that an entity devoid of shape would lack all other geometrical/structural properties (insofar as any such property must be linked to shape) and would also lack any other sort of categorical property, like qualitative properties. If there are any intrinsic irreducible qualitative categorical properties (analogous to colour, perhaps, if it were intrinsic and irreducible), then they must be dependent on geometrical/structural categorical properties. Colour needs a surface etc. It is difficult (impossible?) to name an uncontroversially qualitative categorical physical property that does not somehow rely on structural categorical properties. (For present purposes I exclude of course mental properties like qualia). If one wishes to dispute the present point, I await such an example!

(B) *The fact that stuff must come shaped, but has no specific shape essentially, is explained by the fact that stuff essentially possesses the irreducible intrinsic determinable categorical property ‘shape’.* This seems much more promising from the categoricist’s perspective. While the status of determinable properties as genuinely irreducible and intrinsic remains a matter of some controversy (e.g., some still wish to reduce determinables to giant disjunctions of determinates), robust realism about determinables is plausible and has been ably defended.²⁰ And recourse to the determinable ‘shape’—or something closely analogous like ‘spatial form’—has the advantage of seeming to fit the bill perfectly: the essential possession of this determinable by stuff would explain why stuff must always possess some shape or other while yet not having any specific shape essentially. After all, to possess a determinable essentially means that the entity must always possess some determinate falling under that determinable,²¹ while leaving open *which* of those determinates does the job.

I don’t claim that (A) and (B) exhaust the categoricist strategies for accommodating the data Markosian’s MaxCon simples present us with, yet it is difficult to see what other strategies could be employed; no specific, determinate categorical property will help (for obvious reasons), and as we just saw in (A), laws won’t help either. There isn’t much else by way of additional, relevant ontological ingredients in the standard nomological necessitarian toolkit. If *determinate* categorical properties and laws of nature are both ruled out, *determinable* categorical properties seem like a good option, especially since the determinable ‘shape’ seems tailor-made to account for the relevant facts concerning stuff.

(B) is thus a *prima facie* reasonable way to go; yet as I will now try to show, (B) has the effect of driving one indirectly towards dispositionalism, insofar as there is a tight but heretofore unappreciated connection between dispositions and a certain class of determinables. To draw out this connection, it will help to begin by refuting two other potential connections one might try to make.

First, one might try to argue that a determinable categorical property *just is* a disposition, more precisely a multi-track disposition (a disposition with multiple manifestation conditions), on the grounds that for anything to have a determinable categorical property like ‘shape’ is *ipso facto* to have an openness, a *capacity*, to possess any of the determinates falling under the range of that determinable (in this case properties like rotundity, triangularity etc.). On this view, to have the determinable ‘shape’ is just to have the power to become round or triangular etc. But this won’t work, insofar as it seems there are beings which possess some specific determinate shape essentially. That is, it seems there are entities genuinely possessed of the determinable categorical property ‘shape’ but which have no resultant capacity to take on other shapes while remaining in existence. Consider for example any number of chemical kinds, a water molecule for instance; these are often thought to have their determinate geometrical structure essentially, such that if the structure were altered the molecule would cease to exist as that kind of molecule. Or consider biological kinds, like a porcupine. A porcupine possesses the determinable categorical ‘shape,’ but that does not bestow

²⁰ See for instance Elder (1996), Fales (1990, Chap. 9), and Wilson (2012).

²¹ That is, anything coloured is always some colour or other, anything shaped is always some shape or other etc.—no real entity in nature is *just* generically ‘coloured’ or ‘shaped.’

upon it the capacity to acquire any determinate of that determinable while remaining in existence. Bend a porcupine too far out of shape, and it will simply be destroyed. So the attempt to draw a tight connection between the irreducible intrinsic reality of determinable categorical properties and the irreducible intrinsic reality of dispositions by simply *identifying* determinables with a certain sort of disposition will not work.

Second, one might try for a slightly subtler connection by arguing that while a determinable categorical property is not *identical* to a disposition, nevertheless it always *entails the presence of* a disposition. On this view, for something to have a determinable categorical property like ‘shape’ is *ipso facto* to have an openness, a *capacity*, to possess any of the determinates falling under the range of that determinable (in this case properties like rotundity, triangularity etc.), not because the determinable is a power, but because it entails the presence of a power. Thus while the determinable is genuinely distinct from the disposition, the presence of the former necessitates the presence of the latter. However, this second attempt at drawing a connection is flawed for precisely the same reason as the first attempt, insofar as the possession of a determinable will not always entail an openness to the possession of any of a range of determinates: that openness will fail to occur whenever the entity in question possesses one determinate of that determinable essentially. (This is an important point the categoricist strategy (B) above failed to recognize explicitly.) And as we’ve just seen, some entities possess one determinate shape essentially, such that they cannot change determinate shape while remaining in existence as that same entity.

Having laid aside those first two attempts to draw a connection between determinables and dispositions, we can now look at a third and see why it actually works for present purposes. The goal again is to show that stuff is possessed of at least one irreducible intrinsic dispositional property, thus establishing premise 2 of the argument of this section. And to do that, one need only point out that while stuff possesses the irreducible intrinsic determinable categorical property ‘shape’ essentially (recall again that for Markosian stuff must always exist with some shape or other), *there is no determinate shape that it possesses essentially*. So, although one cannot *universally* equate determinables with dispositions (the first option), nor *universally* claim that determinables entail the presence of a disposition (as in the second), one can properly claim that when a determinable is possessed by something essentially but no specific determinate of that determinable is possessed essentially, that determinable is either *identical with* an irreducible capacity to take on different determinates, or, more plausibly, *entails the presence of* a distinct and irreducible capacity to take on different determinates. And that is precisely the state of affairs obtaining of Markosian’s stuff. Stuff is essentially shaped but possesses no determinate shape essentially, such that the relevant determinable ‘shape’ is either identical with a capacity to take on new shapes, or (much more likely) at least implies the presence of such a capacity. This is a capacity possessed irreducibly and intrinsically by stuff—it cannot be reduced or eliminated by reference to the usual ontological tools of nomological necessitarianism, namely extrinsic laws and other categorical properties. There is in fact no room for extrinsic laws or other factors to come into play here: the mere presence of the essentially possessed determinable + lack of an essential determinate entails the presence of the power, with no room leftover for an extrinsic law to step in to do the modal heavy lifting. In other words, the presence of the entailed power is just as essential as

the presence of the determinable doing the entailing, and as we saw in the discussion of (A) above, essential intrinsic properties cannot be bestowed by extrinsic laws.

I have indicated that I favour the model of the determinable ‘shape’ entailing a distinct capacity rather than being identical with that capacity. I prefer the former both because it strikes me as *prima facie* more plausible (categorical properties and powers seem to be genuinely different sorts of property), but also because there will be content to the entailed capacity that will not flow from the categorical property alone, that must somehow be specified in an alternate manner. That is, the categorical property ‘shape,’ when possessed essentially but with no accompanying essential determinate, directly entails that the entity possessed of ‘shape’ must have the power to take on new determinate shapes; however, it does not of itself entail the full associated content of that power, e.g., what sorts of causal stimuli will prompt the change in shape, under what conditions, with what *ceteris paribus* clauses etc. An essentially possessed categorical determinable property with no accompanying essential determinate entails a power to take on new determinates, but is best thought of as genuinely distinct from that entailed power, because that power will have to possess additional content not specified by the entailing determinable.²²

That last passage might sound rather technical, but the basic idea is commonsensical: consider silly putty as an analogue for stuff. Silly putty is analogous to stuff insofar as it must possess some shape or other, while having no determinate shape essentially. I.e., silly putty has a categorical determinable property essentially, but no accompanying essential determinate of that determinable. This directly entails that silly putty has the capacity to take on new determinate shapes. But the determinable ‘shape,’ while directly entailing the presence of that capacity, does not of itself determine the entire content of that capacity—thus ‘shape’ does not determine the degree of force required to manipulate silly putty effectively, does not determine which environmental conditions impact this manipulability (e.g., extreme cold temperatures), etc. As such, ‘shape’ is best seen as genuinely distinct from that capacity.²³

4 Conclusion

To recap, I have developed and defended the following argument outlined in the Introduction:

²² And what fills in that additional content? Since it must be another essential intrinsic aspect of the entity, I would argue that the best candidate is the entity’s *natural-kind essence*. That natural-kind essence grounds the essential presence of the determinable and likewise fixes the conditions under which the non-essential determinates of that determinable are changed. I would in fact wish to argue that the need to posit an intrinsic ground of these facts constitutes evidence for the reality of an irreducible overarching natural-kind essence of the sort defended by essentialists like Ellis (2001), Lowe (2006) and Oderberg (2007). But that is an argument for another day.

²³ At this point one might ask: why not just run this argument for dispositionalism on silly putty (or some other comparable macro-level stuff), rather than bringing in the whole apparatus of MaxCon simples? Because one can plausibly argue that silly putty (and most other analogous macro-level ‘stuffs’) are fully reducible to collections of individual particles, such that there is really no entity there to possess (uncontroversially) any property, let alone an intrinsic essential determinable. By contrast, MaxCon simples, and the fundamental stuff out of which they are composed, are not thus reducible, such that stuff can (if real) uncontroversially be the bearer of properties, including intrinsic essential determinables.

Assumption Causation is genuinely real and irreducible (i.e., any sort of regularity theory of causation and causal laws is false).

Premise 1 If MaxCon extended simples exist, then there is a real and irreducible distinction between objects and stuff.

Premise 2 If there is a real and irreducible distinction between objects and stuff, then dispositionalism is true.

Conclusion Therefore, if MaxCon extended simples exist, then dispositionalism is true.

Assumption was left undefended, while I sought to justify premise 1 in the Sect. 2, and to justify premise 2 in the Sect. 3.

In my view the link between extended simples and dispositionalism is not the only important connection between these two debates. I believe that atomism also entails the truth of dispositionalism. I cannot argue for this here, but I will just note one motivation for the connection: atoms, being defined as extensionless objects, ipso facto lack all categorical properties. They have no spatial extension, and so have no geometrical/structural categorical properties (or irreducible qualitative categorical properties which, I have claimed, must be ontologically dependent on geometrical/structural categorical properties). Consequently, their intrinsic irreducible properties must be dispositional in nature. This point has been made already [see Mumford (1998, pp. 229–230) and (2006)], but its full import has perhaps not been appreciated. Now, if it is true that both atomism and the theory of extended simples entail dispositionalism, then we are left with the conclusion that categoriclists are obliged to accept the reality of gunk. That is an interesting result in and of itself; but should it then turn out that gunk is irremediably problematic (as indeed I believe it is), that will furnish us with another objection against categoricism, and by extension the nomological necessitarian ontology of laws which relies on it. However, the pursuit of that argument is a larger project for another time.

Acknowledgements I would like to extend my sincere thanks to Evan Fales, Tuomas Tahko, and several anonymous referees for *Synthese* for their many helpful comments on earlier drafts. In addition, work on this paper was completed thanks in part to generous funding from the Canada Research Chairs program, for which I am grateful to the government and taxpayers of Canada.

References

- Armstrong, D. (1968). *A materialist theory of mind*. London: Routledge.
- Armstrong, D. (1983). *What is a law of nature?*. Cambridge: Cambridge University Press.
- Armstrong, D. (1997). *A world of states of affairs*. Cambridge: Cambridge University Press.
- Armstrong, D. (2010). *Sketch for a systematic metaphysics*. Oxford: Oxford University Press.
- Balashov, Y. (2002). What is a law of nature? The broken-symmetry story. *Southern Journal of Philosophy*, 40, 459–475.
- Barker, S. (2013). The emperor's new metaphysics of powers. *Mind*, 122, 605–653.
- Bauer, W. (2012). Four theories of pure dispositions. In A. Bird, B. Ellis, & H. Sankey (Eds.), *Properties, powers, and structures: Essays in the metaphysics of realism* (pp. 139–162). London: Routledge.
- Bauer, W. (2013). Dispositional essentialism and the nature of powerful properties. *Disputatio*, 5, 1–19.
- Beebe, H. (2011). Necessary connections and the problem of induction. *Nous*, 45, 504–527.
- Bird, A. (2006). Potency and modality. *Synthese*, 149, 491–508.
- Bird, A. (2007). *Nature's metaphysics: Laws and properties*. Oxford: Clarendon Press.

- Bostock, S. (2008). A defence of pan-dispositionalism. *Metaphysica*, 9, 139–157.
- Braddon-Mitchell, D., & Miller, K. (2006). The physics of extended simples. *Analysis*, 66, 222–226.
- Chakravartty, A. (2007). *A metaphysics for scientific realism: Knowing the unobservable*. Cambridge: Cambridge University Press.
- Coleman, M. (2010). Could there be a power world? *American Philosophical Quarterly*, 47, 161–170.
- Dretske, F. (1977). Laws of nature. *Philosophy of Science*, 44, 248–268.
- Dumsday, T. (2013). Laws of nature don't have ceteris paribus clauses, they are ceteris paribus clauses. *Ratio*, 26, 134–147.
- Elder, C. (1996). Realism and determinable properties. *Philosophy and Phenomenological Research*, 56, 149–159.
- Ellis, B. (2001). *Scientific essentialism*. Cambridge: Cambridge University Press.
- Ellis, B. (2002). *The philosophy of nature: A guide to the new essentialism*. Montreal: McGill-Queen's University Press.
- Ellis, B. (2009). *The metaphysics of scientific realism*. Montreal: McGill-Queen's University Press.
- Fales, E. (1990). *Causation and universals*. New York: Routledge.
- Fine, K. (1994). Essence and modality. *Philosophical Perspectives*, 8, 1–16.
- Forrest, P. (2004). Grit or gunk: Implications of the Banach-Tarski paradox. *Monist*, 87, 351–370.
- Foster, J. (2004). *The divine lawmaker: Lectures on induction, laws of nature, and the existence of god*. Oxford: Oxford University Press.
- Franklin, J. (1986). Are dispositions reducible to categorical properties? *Philosophical Quarterly*, 36, 62–64.
- Giberman, D. (2012). Against zero-dimensional material objects (and other bare particulars). *Philosophical Studies*, 160, 305–321.
- Handfield, T. (2005). Armstrong and the modal inversion of dispositions. *Philosophical Quarterly*, 55, 452–461.
- Heil, J. (2003). *From an ontological point of view*. Oxford: Oxford University Press.
- Heil, J. (2005). Dispositions. *Synthese*, 144, 343–356.
- Holden, T. (2004). *The architecture of matter: Galileo to Kant*. Oxford: Oxford University Press.
- Jacobs, J. (2010). A powers theory of modality: Or, how i learned to stop worrying and reject possible worlds. *Philosophical Studies*, 151, 227–248.
- Jacobs, J. (2011). Powerful qualities, not pure powers. *Monist*, 94, 81–102.
- Lange, M. (2004). A note on scientific essentialism, laws of nature, and counterfactual conditionals. *Australasian Journal of Philosophy*, 82, 227–241.
- Lange, M. (2009a). Why do the laws explain why? In T. Handfield (Ed.), *Dispositions and causes* (pp. 286–321). Oxford: Oxford University Press.
- Lange, M. (2009b). *Laws and lawmakers: Science, metaphysics, and the laws of nature*. Oxford: Oxford University Press.
- Latham, N. (2011). Are fundamental laws necessary or contingent? In J. K. Campbell, M. O'Rourke, & M. Slater (Eds.), *Carving nature at its joints: Natural kinds in metaphysics and science* (pp. 97–112). Cambridge: MIT Press.
- Lewis, D. (1986). *A plurality of worlds*. Oxford: Oxford University Press.
- Lowe, E. J. (2006). *The four-category ontology: A metaphysical foundation for natural science*. Oxford: Oxford University Press.
- Mackie, J. (1977). Dispositions, grounds, and causes. *Synthese*, 34, 361–369.
- Markosian, N. (1998). Simples. *Australasian Journal of Philosophy*, 76, 213–226.
- Markosian, N. (2004). Simples, stuff, and simple people. *Monist*, 87, 405–428.
- Maudlin, T. (2007). *The metaphysics within physics*. Oxford: Oxford University Press.
- McDaniel, K. (2007). Extended simples. *Philosophical Studies*, 133, 131–141.
- McDaniel, K. (2009). Extended simples and qualitative heterogeneity. *Philosophical Quarterly*, 59, 325–331.
- McKittrick, J. (2003). The bare metaphysical possibility of bare dispositions. *Philosophy and Phenomenological Research*, 66, 349–369.
- McMullin, E. (1978). Structural explanation. *American Philosophical Quarterly*, 15, 139–147.
- Mumford, S. (1998). *Dispositions*. Oxford: Oxford University Press.
- Mumford, S. (2004). *Laws in nature*. New York: Routledge.
- Mumford, S. (2006). The ungrounded argument. *Synthese*, 149, 471–489.
- Nagasawa, Y. (2012). Infinite decomposability and the mind-body problem. *American Philosophical Quarterly*, 49, 357–367.

- Newman, A. (2013). On the constitution of solid objects out of atoms. *Monist*, 96, 149–171.
- Oderberg, D. (2007). *Real essentialism*. London: Routledge.
- O’Shaughnessy, B. (1970). The powerlessness of dispositions. *Analysis*, 31, 1–15.
- Parsons, J. (2000). Must a four dimensionalist believe in temporal parts? *Monist*, 83, 399–418.
- Pasnau, R. (2011). *Metaphysical themes: 1274–1671*. Oxford: Oxford University Press.
- Prior, E. (1982). The dispositional / categorical distinction. *Analysis*, 42, 93–96.
- Psillos, S. (2006). What do powers do when they are not manifested? *Philosophy and Phenomenological Research*, 72, 137–156.
- Psillos, S. (2009). *Knowing the structure of nature: Essays on realism and explanation*. New York: Palgrave Macmillan.
- Quine, W. V. O. (1966). *The ways of paradox and other essays*. Cambridge: Harvard University Press.
- Scala, M. (2002). Homogenous simples. *Philosophy and Phenomenological Research*, 64, 393–397.
- Schaffer, J. (2003). Is there a fundamental level? *Nous*, 37, 498–517.
- Sider, T. (1993). Van Inwagen and the possibility of gunk. *Analysis*, 53, 285–289.
- Sider, T. (2006). Bare particulars. *Philosophical Perspectives*, 20, 387–397.
- Sider, T. (2007). Parthood. *Philosophical Review*, 116, 51–91.
- Simons, P. (2004). Extended simples: A third way between atoms and gunk. *Monist*, 87, 371–384.
- Smart, B. (2013). Is the humean defeated by induction? *Philosophical Studies*, 162, 319–332.
- Thompson, I. J. (1988). Real dispositions in the physical world. *British Journal for the Philosophy of Science*, 39, 67–79.
- Toner, P. (2008). Emergent substance. *Philosophical Studies*, 141, 281–297.
- Toner, P. (2011). Independence accounts of substance and substantial parts. *Philosophical Studies*, 155, 37–43.
- Tooley, M. (1977). The nature of laws. *Canadian Journal of Philosophy*, 74, 667–698.
- Tooley, M. (1987). *Causation: A realist approach*. Oxford: Oxford University Press.
- Tugby, M. (2013). Platonic dispositionalism. *Mind*, 122, 451–480.
- van Inwagen, P. (1981). The doctrine of arbitrary undetached parts. *Pacific Philosophical Quarterly*, 62, 123–137.
- Wilson, J. (2012). Fundamental determinables. *Philosophers’ Imprint*, 12, 1–17.
- Zimmerman, D. (1996a). Indivisible parts and extended objects: Some philosophical episodes from topology’s prehistory. *Monist*, 79, 148–181.
- Zimmerman, D. (1996b). Could extended objects be made out of simple parts? An argument for ‘Atomless Gunk’. *Philosophy and Phenomenological Research*, 51, 1–29.