

Endurance and Parthood

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Abstract

This is a work in analytic metaphysics, which addresses a cluster of interrelated issues at the interface of mereology and persistence over time. In particular, it outlines a defence of a version of Endurance Theory according to which every enduring object is either a mereological simple or a mere sum of mereological simples. It includes, among other things, a proposal of a new way of framing the debate between Endurance Theory and Four-Dimensionalism, a defence of Endurance Theory over Four-Dimensionalism, arguments against the existence of compound substances, and a defence of a traditional metaphysical atomism according to which all objects are ultimately made up of microscopic simples.

Declaration

I confirm that this is my own work and that the use of all material from other sources has been properly and fully acknowledged.

This thesis has also not been submitted for any degree in any university previously.

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Introduction

This work addresses a cluster of interrelated issues at the interface of mereology and persistence over time. Each chapter is intended as a self-contained contribution to some contemporary debate in analytic metaphysics. Nevertheless, all the chapters together deliver a general picture of the way objects persist and of the relations between them and their parts. The outcome is a view according to which objects endure, and every enduring object is either a mereological simple or a mere sum of simples. Each of the chapters from 1 to 7 addresses a specific issue, whereas chapter 8 draws the comprehensive picture that results from the previous chapters and defends it from some obvious objections.

One of the main debates in contemporary metaphysics is the dispute between Endurance Theory and Four-Dimensionalism, which is standardly described as a debate about persistence over time. In spite of the centrality of the debate, there is no agreement about how to formulate Endurance Theory and Four-Dimensionalism. With this in mind, chapter 1 is aimed at finding the best way of framing the dispute between those two views. First, I examine the flaws of the dominant approach to framing the debate and I suggest that their core mistake has been to assume that what is at stake in the debate is persistence: as a result, those approaches try to formulate Endurance Theory and Four-Dimensionalism by employing the concept of persistence itself or related concepts, such as that of presence-at-a-time. Prominent examples of this strategy are the Locational Theory of Persistence and the Transcendentist Theory of Persistence recently put forward by Costa. I show that both of those approaches are variously flawed, because generally (i) they do not do justice to the spirit of Endurance Theory and Four-Dimensionalism, and (ii) they do not frame the debate in a neutral way, but rather favour one view over the other.

As an alternative, I argue that the dispute between Endurance Theory and Four-Dimensionalism should be rather phrased as a debate primarily about *change*. At first approximation, Endurance Theory is to be formulated as the view that objects can exemplify incompatible properties directly; by contrast, Four-Dimensionalism is to be formulated as the view that objects have incompatible properties only as relational properties. I show that this way of formulating the two theories has various virtues: generally, unlike the previous approaches, it does justice to both the sides of the debate and enables us to frame the dis-

pute in a neutral way. Furthermore, it does a good job of accommodating certain anomalous views, which would be otherwise hard to classify under Endurance Theory or Four-Dimensionalism. In the final section, I suggest that the questions about persistence are to be delayed to a later stage of the inquiry: once we have framed the debate in the way that I propose, we can ask – and eventually answer – questions about persistence and presence-at-a-time.

In chapter 2, I challenge one of the best-known arguments in favour of Four-Dimensionalism over Endurance Theory, which is the Argument from Temporary Intrinsic. It has been widely argued that Four-Dimensionalism – Exdurance Theory in particular – is better off than Endurance Theory when it comes to accommodating temporary intrinsics: endurance theorists have to accept that ordinary objects have intrinsic properties only under some temporal qualifications, whereas exdurance theorists can grant that those properties are exemplified by ordinary objects *simpliciter*. In this chapter, I argue first that exdurance theorists cannot resort to the Argument from Temporary Intrinsic without maintaining that actual momentary objects are necessarily momentary. Then, I show that this necessitarian version of Exdurance Theory faces a dilemma concerning dispositions: if ordinary objects can undergo change only by having later counterparts with appropriate features, the manifestations of their dispositions consist, among the other things, in their later counterparts having certain features. I examine the two ways available to account for such dispositions, showing that both of them are troublesome: the first option is to maintain that their dispositions are rigid relational properties that they entertain with their later counterparts; the alternative is to maintain that those dispositions are qualitative properties and that an ordinary object being disposed to affect its later counterparts does not consist in that object entertaining a rigid relation with them. The first option leads to a view of temporary intrinsics that is more revisionary than that required by Endurance Theory, which undermines the very strategy behind the argument. The second option allows one to maintain that temporary intrinsics are exemplified *simpliciter*, but it also leads to a highly implausible view of dispositions. In either case, the Argument from Temporary Intrinsic cannot be invoked to support Exdurance Theory over Endurance Theory.

In chapter 3, I outline one of my two main arguments in favour of Endurance Theory over Four-Dimensionalism. The starting point of the argument is a concern about the place of dispositions within the ontology of Four-Dimensionalism. I argue that – even

independently from the concerns with the Argument from Temporary Intrinsic raised in chapter 2 – four-dimensionalists, be they perdurance theorists or endurance theorists, have a hard time accommodating dispositions; by contrast, endurance theorists can accommodate them with no theoretical cost.

Indeed, endurance theorists can simply maintain that persisting objects undergo the changes involved in the manifestation of their dispositions just by having contradictory properties at different times. I show that this option is not straightforwardly available to four-dimensionalists, who instead have to maintain that momentary objects are somehow disposed to affect their later temporal counterparts. I explore the available ways of working out this view, and then I argue that the most promising one is to endorse a version of the Best System Account of laws of nature defended by Loewer and Hall: according to such a view, dispositions are “manufactured” properties, which means that they are non-natural, relational properties that consist in fitting certain patterns of spatiotemporal arrangement. I argue that even this strategy might ultimately fail, because that view of dispositions and laws of nature faces various problems. The conclusion is that, given the current state of the debate, Endurance Theory is much better off than Four-Dimensionalism at accommodating dispositions.

In chapter 4, I outline my second argument in favour of Endurance Theory over Four-Dimensionalism. The argument starts from the observation that those two theories have different underlying views of the ontic stability of objects. Endurance theorists endorse the view that ordinary objects tend to remain in existence unless some perturbation makes them pass away. By contrast, four-dimensionalists maintain that the world is made up of momentary objects, which pass away instantaneously and are eventually replaced by later objects that have some appropriate continuity with the earlier ones. In this chapter, I argue that this basic difference, though overlooked in the literature on the topic, is relevant to the adjudication of the debate between Endurance Theory and Four-Dimensionalism.

First, I show that endurance theorists have only to maintain that objects are disposed to remain in existence in certain conditions and to pass away in other conditions, and that this view can be worked out just by appealing to the causal structure of the world as it is studied by natural science. At the end of the day, endurance theorists do not need to posit any special metaphysical principle or to impose any constraint on the space of metaphysical possibilities. By contrast, the continuous replacement theorized by four-dimensionalists can only be accommodated either by invoking special dispositions or by

imposing certain constraints on the modal space. I show that this asymmetry obtains no matter which regimentation of the two theories one prefers. Finally, I conclude that this asymmetry counts in favour of Endurance Theory over Four-Dimensionalism.

In chapter 5, I defend a version of ontological eliminativism by arguing against the existence of compound substances – namely, enduring compound objects that are, in some sense, something over and above their proper parts. After a preliminary discussion, I single out the two best ways of working out a view of compound substances: the first one, is to endorse some version of hylomorphism; the second one, is to deny the mereological principle of Weak Supplementation and Strong Supplementation, admitting that a compound substance can be distinct from the aggregate of its material constituents even though it does not have any further proper parts. Then, I argue that – no matter which option they prefer – the defenders of compound substances have to account for the metaphysical determination of those substances by their lower-level proper parts. I examine the strategies available to meet that requirement and I show that each of them leads either to absurdities or to *ad hoc* assumptions. I conclude that these difficulties provide a *reductio ad absurdum* of the existence of compound substances.

In chapter 6, I outline an argument for the actual existence of mereological simples. Indeed, every metaphysical atomism has to address what is a common assumption in contemporary metaphysics – namely, the possibility of gunk: gunk is supposed to be an atomless matter that can be further divided *ad infinitum*, without ever realising mereological simples. The possibility of gunk has gone nearly uncontested in contemporary metaphysics: indeed, a view being incompatible with the possibility of gunk is often taken as a case against that view. The epistemic possibility of gunk has been also defended by appealing to hypotheses made in theoretical physics. By contrast, attempts to build arguments in favour of the existence of mereological simples have been scant in the literature.

I show that, on the contrary, an argument against the possibility of gunk can be worked out by combining Mereological Fundamentalism with a suitable account of ontological dependence. First, I work out an account of ontological dependence in terms of individuation and then I show that this offers an appropriate regimentation of commonly shared beliefs about priority and dependence between entities. Then, I show that the combination of this framework with Mereological Fundamentalism entails that all objects

are ultimately made up of simples, since otherwise there would be objects that lack a complete individuation. Finally, I also show that this inquiry sheds light on the priority structure of the cosmos as well, offering a case against Schaffer's Priority Monism.

In chapter 7, I address the question about the nature of those mereological simples. According to the common view, the only plausible candidates as mereological simples are some of the microscopic objects studied by fundamental physics, such as elementary particles, strings, or maybe something else still to be discovered. Nevertheless, metaphysicians have also considered revisionary views such as Existence Monism – namely, the view that the whole cosmos is made up of only one mereological simple, which is the cosmos itself. Even those who accept this view must grant that the cosmos exhibits vast qualitative variations. On the other hand, an object that is qualitatively heterogeneous seems to have proper parts with different qualities. To account for this phenomenological datum, existence monists need to explain how a simple object can be qualitatively heterogeneous.

I argue, by elimination of alternatives, that no option available to them is successful: therefore, qualitatively heterogeneous simples are metaphysically impossible. With this in mind, I conclude that our cosmos is not mereologically simple and I vindicate the common view: certain microscopic objects studied by subatomic physics are, indeed, the only plausible candidate as simple objects.

In chapter 8, I outline a comprehensive metaphysical picture and I defend it from some obvious objections. First, I summarise the view that results from the previous chapters: the world is ultimately made up of mereological simples, which are microscopic objects. Every object is either a simple or a mere sum of simples; both simples and their mere sums endure. Then, I address two major objections that this picture is exposed to. First, one might object that irreducible compounds are needed for scientific explanations, because they are the only entities suited to bear emergent dispositions, such as liquidity or fragility. In response to this objection, I argue that mere sums of simples are actually suited to bear emergent dispositions: thus, an ontology of simples and mere sums of simples is enough for scientific explanations.

The other objection that I address is that, according to the present view, there are no ordinary objects: indeed, ordinary objects are not microscopic simples, but they do not seem to be mere sums of simples either. I respond by defending a relaxed but non-arbitrary criterion for what is to count as an ordinary object: according to this criterion, certain mere

sums of simples qualify as ordinary objects, in so far as they are suited to occupy a certain role. Finally, I show that this eliminative picture delivers a solution to the puzzles of material constitution similar to that delivered by Four-Dimensionalism; this is a substantial dialectical achievement, since such a solution is considered by many to be the main case in favour of Four-Dimensionalism over the standard versions of Endurance Theory.

Chapter 1. Persistence Without “Persistence”

Introduction

There is an ongoing debate in metaphysics between the defenders of Endurance Theory and those of Four-Dimensionalism. A quick and popular way to formulate Endurance Theory is to state it as the view that ordinary objects – objects such as persons, chairs or rocks – are *wholly present* at different times. By contrast, Four-Dimensionalism is standardly stated as the view that ordinary objects have momentary stages – namely, objects that exist for a very brief, possibly instantaneous time. With this in mind, ordinary objects are not present at different times wholly, but only *partially*, in so far as they have stages that exist at those times.

Endurance Theory and Four-Dimensionalism are commonly viewed as competing theories about persistence through time – more specifically, about how objects persist through time. It seems that objects are somehow present at different times: Michael Jordan was present at 1993, and he is also present now. The usual way to frame the debate is that both Endurance Theory and Four-Dimensionalism accept this platitude, but they offer different accounts of the way objects are present at different times: according to Endurance Theory, Michael Jordan was wholly present at 1993 and is wholly present at the current time. According to Four-Dimensionalism, Michael Jordan has a multitude of momentary, short-lived stages spread across the temporal axis: one of those stages is present at 1993, another one is present at the current time.

Four-Dimensionalism comes in two main varieties, which are Perdurance Theory and Exdurance Theory. When it comes to persistence, according to Perdurance Theory an ordinary object is made up of short-lived, momentary stages, and it is present at many times by having stages located at those times. According to Exdurance Theory, an ordinary object – such as, say, Michael Jordan – just is identical to a momentary object, and it is present at other times vicariously, in so far as there are counterparts of it at that time.

It is easy to grasp the appeal of the formulation of Endurance Theory above: as we have seen, according to Four-Dimensionalism objects persist by having stages that are present at different times. According to Perdurance Theory, those stages are proper parts of the ob-

ject; according to Endurance Theory, those stages are mereologically distinct from the object itself, but they are related to it by some appropriate kind of continuity. With this in mind, to talk about an object being wholly present at different times is the most obvious way to contrast Endurance Theory with Four-Dimensionalism: Four-Dimensionalism states that objects are present at different times only partially, whereas Endurance Theory states that objects are wholly present at different times. The problem with this quasi-mereological formulation of Endurance Theory is that, if taken literally, it results into a view that is wildly implausible, and that as a matter of fact is not the kind of view that endurance theorists commonly have in mind. If taken literally, this formulation says that *all* the parts of an ordinary object are present at any time when that object exists: under this reading, Endurance Theory is incompatible with persisting objects changing their proper parts over time.

With this in mind, there are two worries with this formulation, the first being exegetical and the second dialectical. The exegetical worry is that, as a matter of fact, endurance theorists are inclined to admit that persisting objects change their proper parts over time: to phrase Endurance Theory in this way would give us an inaccurate picture of one of the sides of the debate. The dialectical worry here is that whether objects change their proper parts over time or not should be assessed on the basis of further considerations, not on the ground of a theory of persistence alone.

Given the flaws of the naïve formulation of Endurance Theory, metaphysicians have been searching for a more rigorous way to frame the debate between Endurance Theory and Four-Dimensionalism. If one wants to understand in what sense an object can be “wholly” or “partially” present at a time, the most obvious move seems to analyse the concept of presence-at-a-time: it seems that to frame the debate one needs to have a view of what is for an object to be present at a time without being thereby committed to any theory of persistence. To put it in a different way, one first need what I will call *Minimal Theory of Persistence*: the purpose of a Minimal Theory of Persistence is to answer the question “What is for an object to be present at a time?”.

1. Minimal Theories of Persistence

The role of a Minimal Theory of Persistence can be made clear through an analogy with mereology. Mereology – broadly construed – is the study of the relationships between parts and wholes. A formal system of mereology explicates the concept of (proper) parthood

through certain axioms, such as the principles of anti-reflexivity, asymmetry and transitivity: taken together, those axioms tell us what is for an entity to be part of another entity. Nevertheless, there are questions about parts and wholes that go beyond the scope of formal systems of mereology: for instance, whether there are objects with proper parts (i.e. compound objects) at all; whether there are objects with no proper parts (i.e. mereological atoms); whether each compound object is identical to the mere sum of its proper parts; whether objects have as proper parts only other objects or also entities from different ontological categories, such as tropes or universals. All of those are substantive and widely debated issues, which can be viewed as belonging to the domain of mereology broadly construed, but not to the domain of formal – or, if you want, *minimal* – mereology.

As in the case of minimal mereology, the *desiderata* for a Minimal Theory of Persistence are settled not only by what we expect the theory to answer, but also by what we expect it not to answer: there are questions related to persistence that a Minimal Theory of Persistence should not answer. In particular, a basic requirement for a Minimal Theory of Persistence is that it does not tell us how objects persist. To put it in a different way, the Minimal Theory of Persistence should stay neutral on the debate between Endurance Theory and Four-Dimensionalism – or any other competing theory, for that matter. The motivation underlying this requirement is that the dispute between Endurance Theory and Four-Dimensionalism is not the kind of dispute that can be settled only by analysing a concept such as that of presence-at-a-time: it is, rather, a substantive debate about the nature of things. The desirable outcome of a Minimal Theory of Persistence is to help us to frame the debate, not to end it.

With this in mind, a Minimal Theory of Persistence should include two components: (i) first, it should include (i) an account of what is for an object to be present at a time; second, it should include (ii) a formulation of Endurance Theory and one of Four-Dimensionalism, both based on that account of presence-at-a-time. The second component is, in a sense, meta-theoretical: it is not concerned with the way things are, but with the way theories (about things) are. In what follows, I will examine the two main candidates as a Minimal Theory of Persistence in the market.

The most popular candidate as Minimal Theory of Persistence is the Locational Theory of Persistence. This framework assumes an ontology of spatiotemporal regions and a primitive relation of exact location, which is supposed to obtain between objects and regions. Presence-at-a-time is analysed in terms of exact location at a spatiotemporal region. The

concept of exact spatiotemporal location can be explicated by starting from the more intuitive concepts of spatial location. When a man is sleeping in a bedroom, he is *weakly occupying* various sub-regions of the whole bedroom: generally, an object *a* weakly occupying a region *r* consists, so to speak, in *r* being not completely free of *a* (Parsons 2007: 203). On the other hand, the man exactly occupies only one spatial region, which is the region that overlaps¹ with all and only the regions that he weakly occupies: that is, intuitively, the region that has exactly the same shape and size as the man, and that he fills completely, without there being any part of him left outside that region. Given these preliminaries, the concept of exact spatiotemporal location can be viewed as the spatiotemporal analog of exact spatial location, with the “places” of location being spatiotemporal regions rather than merely spatial regions.

That was the first part of this Minimal Theory. Next comes the second component, which is the formulation of Endurance Theory and Four-Dimensionalism: according to the Locational Theory of Persistence, the demarcation between them lies in the answer that they give to the question “Where are objects located (in the spacetime)?”. According to the Locational Theory of Persistence, Endurance Theory states that persisting objects are exactly located at many times, whereas Four-Dimensionalism denies that. In particular, Endurance Theory states that an ordinary object is exactly located at only one temporally extended region; only some of its temporal parts – the momentary ones – are exactly located at instantaneous regions. By contrast, Endurance Theory states that an ordinary object is exactly located at an instantaneous region, and its temporal counterparts are located at instantaneous regions as well.

As one can easily see, the Locational Theory of Persistence is constructed as a regimentation of more informal phrasings of Endurance Theory and Four-Dimensionalism: the proto-theoretical, endurantist claim that ordinary objects are “wholly present” at different times is regimented as the claim that objects are exactly located at many instantaneous regions. Likewise, the locational formulation of Four-Dimensionalism regiments the “... doctrine that temporally extended things divide into temporal parts” (Sider 1996: 434) in a way analogous to the way they divide into spatial parts.

Even though it regiments certain common views, the Locational Theory of Persistence has various flaws, which make it inadequate as Minimal Theory of Persistence. The first

¹ Two regions overlap if and only if they have some sub-region in common. See Simons 1987 for a comprehensive treatment of formal mereology and Casati and Varzi 1999 for a seminal treatment of mereotopology – namely, the study of the mereological structure of space. See also Gilmore 2018 for a survey of the relations between mereology, space, and location.

worry is that, as Costa (2017) highlights, it does not do justice to the spirit of Endurance Theory: according to this framework, Endurance Theory is committed to ordinary objects being multiply located across the temporal axis. This is a rather revisionary claim, which flies in the face of the common proto-theoretical intuition that Endurance Theory – no matter whether it is true or false – is more commonsensical than Four-Dimensionalism. A view that is so revisionary cannot be the right regimentation of Endurance Theory.

Another problem with the Locational Theory of Persistence is that it is committed to Spacetime Substantivalism – namely, the view that there are spatiotemporal regions: indeed, spatiotemporal regions are needed as *relata* of the relation of spatiotemporal location. But Spacetime Substantivalism is not obviously true: instead, one might be more inclined to endorse a relational view of spacetime, according to which there are no such things as spatiotemporal regions or places, but only objects that stand in spatiotemporal relations to each other. This is a live theoretical option, so one should not frame the debate about persistence in a way that rules it out from the start. Furthermore, as Costa (2017) also notices, the Locational Theory of Persistence is committed to the existence of instants, which is also non-obvious and indeed controversial (see Oderberg 2006).

As an alternative to the Locational Theory of Persistence, Costa (2017) has proposed another Minimal Theory of Persistence, which he has called *Transcendentist Theory of Persistence*². While the Locational Theory takes as primitive the location relation between objects and spatiotemporal regions, the Transcendentist Theory takes as primitive the location relation between an event and a temporal interval: the only entities that have a temporal location non-derivatively are events. By contrast, objects are located at times only in a derivative way, by entertaining the relation of participation with events: an object exists/is present at a time t if and only if it participates in an event e occurring at t , and it exists/is present at t because it participates in e .

Some clarifications are needed to continue the discussion of Costa's framework. Let us assume that participation is the inverse relation of occurring: an object a participating in the event e just is e occurring to a . It is hard to see any other way to explicate the concept

² Actually, Costa (2017) is primarily interested in formulating a defensible version of Endurance Theory. Nevertheless, he suggests that his framework can be combined with Four-Dimensionalism as well. It is also worth noticing that Costa uses "Transcendentist Theory of Persistence" to refer to his version of Endurance Theory. Given the focus of the present chapter, I will rather use that phrase to refer to Costa's account of location/presence-at-a-time.

of participation: if one is not happy with this way, one has the burden of finding an alternative. My next step is to assume that some kind of constitution relation obtains between events: an event can have other events as proper constituents. (Here, I will not be concerned with the question whether that constitution can be analysed as parthood or not.) Given an event e with other events as constituents, I will call those *sub-events* of e . Among the sub-events of e , there are some that I will call *phases* of e . Let us suppose that an object a explodes: there are microscopic changes occurring to a 's parts, which are, arguably, sub-events of the explosion. Nevertheless, those are not phases of the explosion. With this in mind, the intuitive concept of a phase can be defined in the following way: for any event e and e' , e' is a phase of e if and only if (i) e' is a sub-event of e , and (ii) there is no other sub-event of e that is exactly concurrent with e' ³. To put it with an image, the phases of an event are the slices in which you can cut that event along the temporal axis. Every sufficiently extended event e has a number of phases⁴; in particular, the life of a persisting object has a number of phases.

That being said, what about the meta-theoretical component of the Transcendentist Theory of Persistence? Namely, how are Endurance Theory and Four-Dimensionalism going to be formulated within this framework? Costa's own proposal is that Endurance Theory is the view that a persisting object participates in all the phases of its life. This way to frame the debate turns out to be flawed once we investigate more closely what the life of an object is supposed to be. As Costa suggests, the life of an object a is an event that is extended along the entire existence of a . That being said, something more than temporal co-occurrence is needed. Consider two exactly contemporaneous objects a and b : the life of a is extended along the entire existence of both a and b , and so is the life of b ; nevertheless, one is the life of a rather than b , and the other is the life of b rather than a .

Roughly, the life of an object a can be intuitively defined as the complete history of what happens to a . To be more precise, it seems to be the event whose phases are all and only the events that a participates in. Sadly, this definition is inadequate, because it ends the debate in a trivial way: if we accept this definition, the Transcendentist Theory of Persistence trivially entails Endurance Theory, because trivially, for any object x , x participates in all the phases of the event that has as phases all and only the events that x participates in. This

³ Although there might be, of course, other sub-events of e that occur during a subinterval of the interval when e' occurs.

⁴ Actually, some will be inclined to maintain that *all* events have phases, just because all events are temporally extended. On the other hand, one might also argue that there are temporally *minimal* events, which do not have briefer events as parts. I want to grant that this view is not obviously false, which is why I limited my claim to sufficiently extended events.

is just a logical truth! The problem with this way to frame the debate is not only that it alone answers the question about how objects persist over time: it is that it also makes that answer trivial. On the contrary, how the objects persist over time is a substantive metaphysical question that we expect not to follow logically from an analysis of the concept of presence-at-a-time.

With this in mind, Costa's framework needs to be improved by adopting an alternative definition of the concept of the life of an object. A quite natural option is to define the life of an object a as the temporally most extended event that a participates in.

That being said, how can one mark the difference between Endurance Theory and Perdurantism Theory within the present framework? One option is to rely on the participation relation: Endurance Theory might be phrased as the view that an object participates in all the phases of its life. By contrast, Perdurantism Theory might be phrased as the view that no object participates in all the phases of its life. Even if the life of the object has phases, those do not occur to the object itself but, maybe, to its temporal stages. To sum up, the resulting version of Perdurantism Theory would be committed to the view that each persisting object participates in exactly one event – namely, its whole life.

This formulation of the Transcendentist Theory does not entail that Endurance Theory is logically true. Nevertheless, it does not help to frame the debate in a neutral way, because – as I am about to show – (i) it leaves room for a powerful case against Perdurantism Theory, and (ii) it does not do justice to the spirit of Perdurantism Theory. First, it seems that a variety of events occur to an ordinary object: for instance, his birth from Phaenarete and his death by hemlock poisoning are two of the many events that occurred to Socrates. Therefore, it seems that ordinary objects participate in events other than their whole life.

More generally, it is implausible that an object can participate in an event without participating in any of its phases. Again, let us assume that participation is the inverse relation of occurring: an object a participating in the event e just is the event e occurring to a . Take an object a and an event that it participates in: the event e has many phases, and it seems that those phases occur to a as well. For example, an event such as Socrates's death has various phases: those phases of Socrates's death seem to occur to Socrates as well. In general, it seems that if an event occurs to an object a , then all of its phases also occur to a . In the previous section, we have seen that, within Costa's framework, Perdurantism Theory is best stated as the view that each ordinary object participates in exactly one event, which is its life. But that life is temporally extended, so it has phases. Therefore, ordinary objects

are supposed to participate in their life without participating in any phase of their life. As a result, this formulation of Perdurant Theory ends up resting on a highly implausible claim about the relation between ordinary objects and the events that they participate in. The Transcendentist Theory of Persistence does not help to frame the debate between Endurance Theory and Four-Dimensionalism in a neutral way. In conclusion, this way to frame the debate already settles the answer, because it makes Perdurant Theory very implausible.

A further point against this way to frame the debate is that it just does not do justice to the spirit of Four-Dimensionalism. Indeed, four-dimensionalists do not reject the occurrence of change: as a matter of fact, endurance theorists have argued that Four-Dimensionalism is incompatible with the occurrence of change (Oderberg: 2004), but the point is that this is something that one needs to argue for. In the present case, perdurant theorists would not deny that certain events occur to Socrates: they would rather want to grant that Socrates himself undergoes certain brief changes, even though those depend on more basic changes occurring to its temporal parts: the only way to do that is to grant that Socrates participates in events other than his entire life.

2. Change First

In the previous sections, I have discussed two of the most popular candidates as a Minimal Theory of Persistence – namely, the Locational Theory of Persistence and the Transcendentist Theory of Persistence. Sadly, both of them are variously flawed as ways to neutrally frame the debate between Endurance Theory and Four-Dimensionalism. With this in mind, I suggest that it is time to explore an alternative approach, by questioning the very starting point of the previous ones. To put it in a paradoxical way, my idea is to phrase the debate about persistence without invoking either the concept of persistence or cognate concepts, such as that of presence-at-a-time. This must sound odd. A less paradoxical way to phrase my proposal is to say that, contrary to what is commonly assumed, the debate between Endurance Theory and Four-Dimensionalism is not to be understood primarily as a debate about persistence.

Whatever is the best way to frame the debate, one thing is obvious to all the sides involved: Endurance Theory and Four-Dimensionalism are competing theories. Their being competing theories means that (i) they are concerned with the same questions, and (ii) they deliver contradictory answers to those questions. Given these assumptions, the first task to

complete to frame the debate is to assess what is at stake. The nearly unanimous answer is that what Endurance Theory and Four-Dimensionalism are concerned with is persistence: they are both theories about how objects persist over time. Indeed, one might think that not to understand that is equivalent to not understanding the debate at all. As a consequence, the most common strategy to formulate them is to analyse persistence, by resorting to the cognate concept of presence-at-a-time: this is the assumption underlying the attempts to formulate a Minimal Theory of Persistence.

My suggestion is that what is at stake in the debate must be settled by focusing not on persistence, but rather on *change*: Endurance Theory and Four-Dimensionalism are to be viewed primarily as competing accounts of the way objects change. There being a significant relationship between persistence and change is uncontroversial. Indeed, both the sides of the debate are used to arguing that their theory is better at accounting for change. Lewis (1986a) objected that Endurance Theory has the unwelcome implication that temporary properties are not intrinsic to persisting objects. Sider (2001) and Hawley (2001) have argued that the strongest case for Four-Dimensionalism over Endurance Theory is that the former provides a better solution to the puzzles of material constitution, which are concerned with changes in the material constitution of objects. On the other hand, defenders of Endurance Theory have objected that actually Four-Dimensionalism rules out the very possibility of change (Oderberg: 2004). To sum up, both the sides involved in the debate would grant that the choice between Endurance Theory and Four-Dimensionalism has substantial implications for the nature of change, and that the plausibility of those implications is relevant to the assessment of the dispute itself. What is new to the approach that I am proposing is the choice of the starting point. According to the common approach, the debate between Endurance Theory and Four-Dimensionalism is primarily concerned with persistence, even though it has important implications for the nature of change as well. By contrast, I am proposing to start from change itself to frame the debate.

To use the meta-theoretical jargon that I have adopted in section 1 and 2, I contend that to build a Minimal Theory of Persistence is not the right way to frame the dispute between Endurance Theory and Four-Dimensionalism: one should not start from an analysis of the concept of presence-at-a-time. Rather, Endurance Theory and Four-Dimensionalism should be primarily viewed – and phrased – as competing views about change. This alone does not entail that there is no genuine question about what is for an object to persist through time, or to be present at a certain time; it only entails that those questions – if they are worth asking at all – have to wait until a later stage to be answered. In the next section, I will frame

the debate between Endurance Theory and Four-Dimensionalism according to these assumptions. Then, I will argue that this way to frame the debate is preferable to the standard persistence-focused approaches.

If Endurance Theory and Four-Dimensionalism are primarily views about change, then to frame the dispute between them one needs to contrast the endurantist account of change with the four-dimensionalist one. With this in mind, I propose to start from a platitude about change: for an object, to change is to have incompatible properties over time. Here, I will take the incompatibility relation between properties as a primitive: being red (all over) is incompatible with being blue (all over), being round is incompatible with being square, and so on. Given this preliminary clarification, I suggest that Endurance Theory and Four-Dimensionalism are different accounts of the nature of those incompatible properties that change depends on.

According to Endurance Theory, an ordinary object can host incompatible properties directly, but under different temporal qualifications. Those temporal qualifications play a vital role within an endurantist framework, because they are the only way endurance theorists can allow for change without being committed to contradictions: an object can be red and blue, but only if it is blue with respect to a certain time t and red with respect to another time t' . To assess what the best way to regiment those temporal qualifications is, is a major task for defenders of Endurance Theory. It has been suggested by four-dimensionalists that the only option available to them is Relationism, which is the view that intrinsic properties are actually relations that objects entertain with times. On the other hand, defenders of Endurance Theory have also explored alternative views, such as Adverbialism (Haslanger 1989) and Sententialism (Oderberg 2004). For the purposes of the present chapter, I can stay agnostic about this debate: with this in mind, I will freely use phrases like *being F at t* without being committed to any particular analysis of temporal qualifications.

By contrast, it seems that, according to Four-Dimensionalism, no objects at all have incompatible properties: a spatiotemporal worm is not properly red or blue; rather, some of its temporal parts are red, whereas others of them are blue. Likewise, according to Endurance Theory, if an ordinary object is red, then it is not really the case that it is blue, not even under some temporal qualification; rather, it is the case that some of its temporal counterparts are blue. To summarise, it seems that, contrary to Endurance Theory, Four-Dimensionalism denies that objects can have incompatible properties.

At a first approximation, the remarks above help to contrast Endurance Theory with Four-Dimensionalism. But, on closer inspection, four-dimensionalists would hardly be happy with this characterization of their view: indeed, perdurance theorists would insist that a spatiotemporal worm is literally red (at certain times) and blue (at other times); it is just the case that a spatiotemporal worm having those properties depends on its temporal parts having certain properties. Likewise, exdurance theorists would insist that a stage is also blue and red – though in a derivative way, in so far as it has temporal counterparts with certain features. This analysis in terms of dependence and derivativeness is still gross, but we are on the right track: the mark of all the versions of Four-Dimensionalism is that, according to them, the incompatible properties of an ordinary, persisting object are derivative from properties of other objects. According to Perdurance Theory, they are derivative from the properties of the temporal parts of the object; according to Exdurance Theory, from the properties of its temporal counterparts. By contrast, according to Endurance Theory, an ordinary object having incompatible properties over time is just that object having properties under temporal qualification, which does not depend on any fact about other objects.

To make the distinction above more precise, we need to make a further step. In particular, we need to eliminate the discourse in terms of dependence and derivativeness, because this, at a closer look, is not going to work. Indeed, even endurance theorists might want to argue that the intrinsic properties of an enduring object depend on (or are grounded by) the properties of some of its proper parts: for instance, an object being blue seems to be grounded by certain microphysical properties of its material constituents. There is a way to amend this that one can easily think of, which is to invoke temporal parts: Four-Dimensionalism is the view that the incompatible properties of an object are grounded by its temporal parts. At a closer look, this strategy only leads to another formulation of the Locational Theory of Persistence, because the notion of a temporal part should be independently defined in terms of presence-at-a-time.

With this in mind, I suggest abandoning the concept of ontological dependence altogether and searching for another way to contrast endurantist change with four-dimensionalist change. The best alternative seems to me to invoke the distinction between relational and non-relational properties: according to Four-Dimensionalism, if two mutually incompatible properties are exemplified by a persisting object, then at least one of them is a relational property. Here, the key difference between Perdurance Theory and Exdurance Theory is whether those relational properties are internal or external. In general, a relational

property F is internal if and only if an object a being F consists in a having proper parts with certain features. On the other hand, a relational property is external if and only if it is not internal. According to Perdurantism Theory, the mutually incompatible properties of a persisting object are internal relational properties that consist in having temporal parts with certain features. According to Exdurantism Theory, they are external relational properties that consist in having temporal counterparts with certain features: those relational properties qualify as external because, according to Exdurantism Theory, an ordinary persisting object is identical to a stage, so it is mereologically distinct from each of its temporal counterparts.

Let us consider an object a with a red proper part b : a has the relational property of having a red proper part, and a having that property is partially grounded by b being red. By the same token, a having that property is partially grounded by an intrinsic property of its future counterpart. Now, let us rephrase the main claim of Endurantism Theory in a more precise way:

Principle of Endurance: For some object x , for some properties F and G , (i) x has F (at some time) and G (at some time), (ii) F and G are mutually incompatible, (iii) and neither F nor G is a relational property that x entertains with some objects numerically distinct from x .

Likewise, the main claim of Four-Dimensionalism can be stated in the following way:

Stage Principle: For any object x , for any properties F and G , and for any time t , if (i) x has F (at some time) and G (at some time) and (ii) F and G are mutually incompatible, then at least one of F and G is a relational property that x entertains with some objects numerically distinct from x .

The quantification ‘at least one’ is crucial to encompass all versions of Four-Dimensionalism: indeed, whether both F and G or only one of them can be relational depends on the version of Four-Dimensionalism that one is inclined to embrace. According to Perdurantism Theory, both F and G can be relational properties; indeed, both of them are *internal* relational properties that the object entertains with proper parts of itself – namely, its temporal parts. But things are different according to Exdurantism Theory: since an ordinary object is identical to a momentary object, the temporary properties that it has presently are intrinsic to it; by contrast, the temporary properties that it has with respect to non-present

times are relational properties, consisting in external relations that it entertains with its counterparts. Consider an object that is presently red and blue at some future time: in this case, redness is not a relational property of *a*, whereas blueness is.

Some words are needed about the kind of properties that four-dimensionalists have to deal with. On closer inspection, within a four-dimensionalist ontology it is not so straightforward to pick up the properties that we are usually interested in. Consider a present object *a*, which will be red in the future, because it has a later stage *b* with the appropriate features. It is not obvious to which of them we should ascribe redness, and to which only a cognate property of redness. On the one hand, we are inclined to think that the object *a* itself is red at some time. On the other hand, redness seems to be an intrinsic property: *a* cannot be red intrinsically, whereas its temporal counterpart *b* can; with this in mind, we also have reasons to think that only the latter is red *stricto sensu*.

When faced with these alternative options, two possible attitudes are available: the first one is to insist that there is a substantive matter of fact which among the object itself and its temporal stage (be it a temporal part or a temporal counterpart) is red. To put it in a different way, one of those two properties objectively deserves to be denoted as “red”, whereas the other does not. The alternative is to endorse a deflationary attitude: which property we decide to denote by “red” – and, correlatively, which of the two objects turns out to be red – is only a matter of stipulation. That being said, it is possible to endorse this deflationary attitude and nonetheless maintain that not all stipulations are created equal: arguably, a stipulation closer to the way we ordinarily use the word ‘red’ is still to be preferred.

Which of those two options one is inclined to choose is not relevant to the present inquiry: in either case, four-dimensionalists are committed to the view that a persisting object can have contradictory properties only as relational properties that involve other objects, no matter whether those are the properties that we ordinarily talk about or other, more exotic properties derivative from them. With this in mind, we can safely take this view of change to be the mark of Four-Dimensionalism as opposed to Endurance Theory.

A further qualification is required, because endurance theorists might also have reasons to maintain that mutually incompatible properties are relational. Every account of persistence has to deal with the apparent contradictions involved by change. Four-Dimensionalists

elude them from the start, by denying that persisting objects directly instantiate incompatible properties. By contrast, endurance theorists accept that persisting objects do instantiate incompatible properties directly. As I have stressed (p. 6-7), the only way they can avoid contradictions is to resort to some sort of temporal qualifications, and one standard way to analyse those temporal qualifications is offered by the Relationism, according to which temporary properties are actually relations between objects and times.

Even though Relationism is by no means the only approach available to endurance theorists to analyse temporal qualifications, it is at least a live option. At the end of the day, endurance theorists might also have to maintain that temporary properties are relational, but even in that case there would be a major difference with Four-Dimensionalism: according to relational versions of Endurance Theory, the second *relatum* of the relation is not an object, but a time.

3. The Advantages of Starting from Change

In the previous section, I have proposed to frame the debate between Endurance Theory and Four-Dimensionalism as a debate about change, rather than a debate about persistence. In this section, I will argue that this approach has various advantages over the standard persistence-focused approaches – in particular, over the popular Locational Theory of Persistence and over Costa's Transcendentalist Theory of Persistence.

(1) First, my way to frame the debate between Endurance Theory and Four-Dimensionalism does justice to the intuition that the intuitive appeal of the former is greater than that of the latter. Whatever Endurance Theory says exactly, it is more intuitive than Four-Dimensionalism: if a certain formulation of the debate makes Endurance Theory look like the revisionary option in the market, then it is not an adequate formulation of the debate.

As Costa (2017) observes, the Locational Theory of Persistence makes a rather revisionary view out of Endurance Theory: under a locationalist formulation, Endurance Theory says that ordinary objects are multiply located across the temporal axis, which is quite counter-intuitive. On the other hand, even the view put forward by Costa himself does not perform better in that respect, because it also entails that ordinary objects are multiply located across the temporal axis – even though they are located at spatiotemporal regions

only in a derivative way⁵. By contrast, under my formulation, Endurance Theory is nothing but a regimentation of a commonsensical view of change, according to which ordinary objects host incompatible properties directly. The intuitive appeal of Endurance Theory is finally vindicated.

(2) Likewise, my formulation of Four-Dimensionalism coheres with what its defenders take to be the main idea underlying it. According to Sider's characterization, Four-Dimensionalism is "... roughly ... the doctrine that temporally extended things divide into temporal parts" (1996: 434). The idea underlying Four-Dimensionalism is that persisting objects have temporal stages, viewed as objects suited to play a certain theoretical role: the past and future stages of Michael Jordan are stages of Michael Jordan because they are relevant to him changing in a way that other objects are not⁶.

With this in mind, my framework introduces temporal stages directly by specifying the role that they are expected to play: according to Four-Dimensionalism, an object *a* has incompatible properties only as relational properties involving other objects; those other objects are the stages of *a*. This appeal to stages is free from commitments about the way in which stages are connected to each other, or the way in which they are located across spacetime. I take this to be a virtue of my framework: those are issues that four-dimensionalists may disagree about, so they should not be required for the very formulation of Four-Dimensionalism.

3) Another virtue of my approach is that it puts in the right place the theoretical concerns of those involved in the debate. One of the main concerns for those involved in the dispute between Endurance Theory and Four-Dimensionalism, is to elude the apparent contradiction of an object hosting incompatible properties. Endurance theorists have to take this worry at face value, since they accept that a persisting object hosts contrary properties in a direct way. Various strategies have been put forward by endurance theorists, the most discussed being Relationism, Adverbialism, and Sententialism; whether any of those strategies succeed is debatable⁷.

⁵ As I have explained in section 2, Costa (2017) proposes that events (or maybe states of affairs) are primarily located at spatiotemporal regions, whereas the spatiotemporal location of objects is derivative from that of the events in which they participate.

⁶ That being said, those other objects are not completely irrelevant to Michael Jordan changing: actually, they are relevant to him undergoing that kind of metaphysically ephemeral change that is standardly called *Cambridge change*.

⁷ See, among the others, Haslanger 1989 for a defence of Adverbialism and Oderberg 2004 for a defence of Sententialism; both the strategies were originally suggested by Lowe (1988). Four-dimensionalists have

By contrast, four-dimensionalists simply elude those troubles from the start, by maintaining that, indeed, no object hosts incompatible properties directly. This straightforward way to overcome the paradoxes of change has been often presented as the greatest appeal of Four-Dimensionalism as opposed to Endurance Theory. With this in mind, my regimentation of the debate just incorporates the main selling point of Four-Dimensionalism into the very formulation of the view, hence doing justice to the theoretical motivations of its defenders.

(4) Another advantage of my regimentation of the debate over the alternatives is that, under my formulation, Four-Dimensionalism does not entail the existence of instants – namely, unextended times. According to the Locational Theory of Persistence, Four-Dimensionalism is committed to the existence of momentary objects, which actually occupy instantaneous spatiotemporal regions. The existence of instantaneous times (or instantaneous spacetime regions) is not obvious, and as a matter of fact, the existence of instants has been questioned by metaphysicians (Oderberg: 2006). Indeed, it is worth noticing that sometimes four-dimensionalists have been hesitant to assume instantaneous objects, preferring rather to talk loosely about “short-lived” objects, or objects that exist only for a “brief enough time”. With this in mind, it is undesirable for defenders of Four-Dimensionalism to build that commitment into the very formulation of their view. In so far as we want to be charitable, it is preferable to frame the debate about persistence without ascribing to four-dimensionalists a controversial commitment. My framework has the advantage of conveying no commitment about the existence of instants or instantaneous objects.

There is, of course, an intuitive sense in which, to use a metaphor, a momentary object is a still frame, even according to the approach that I am proposing. But it is not a still frame in the sense that it is supposed to exist for exactly one instant: rather, in the sense that it hosts no change within itself. To keep on with this filmic metaphor, it is only its arrangement into a series together with other frames that generates change. Indeed, one might be tempted to describe momentary objects as *changeless* objects, but this would not be fair to the point of view of four-dimensionalists. In particular, to deny that is vital for Endurance Theory to save phenomena. It seems like a platitude that ordinary objects undergo change

sometimes argued that those alternatives actually amount to a Relationism in disguise: according to Sider “... such circumvention accomplishes little” (2001: 96); see also Hinchliff 1996 for a criticism along the same lines.

and – according to Endurance Theory – ordinary objects just *are* momentary stages: unless they are willing to reject that platitude, stage theorists have to maintain that momentary stages themselves undergo change. Their standard move is to maintain that for an ordinary object to undergo change is to have temporal counterparts with different properties. Needless to say, one can object that this account of change is not satisfactory, and as a matter of fact, four-dimensionalist accounts of change have been attacked by defenders of Endurance Theory (see Oderberg 2004); but this should be argued, rather than built into the very formulation of Four-Dimensionalism.

So, how short-lived are stages? My framework leaves four-dimensionalists free to choose between three options. First, (1) they can posit instants or, alternatively, instantaneous regions of spacetime. An instant can be taken to be an unextended time, or a time with no proper sub-interval: such an unextended time is not long enough to host change, which entails that momentary objects are prevented from undergoing change. Alternatively, an instant can be directly defined, in a semi-stipulative way, as a time when no change can occur; this second definition might be preferable for those who find problematic to talk about duration-less portions of time. This view also entails that a momentary object cannot undergo change.

The second option is to maintain that (2) there are momentary objects, but those are simply objects that, as a matter of fact, do not undergo any change. This view admits the possibility of a momentary object existing for a time that allows for change but without undergoing any actual change during that time. According to this latter option, a persisting object is sliced into stages by the actual changes that it undergoes: a persisting object has a numerically distinct stage for every change that occurs to it.

Those who want to stay liberal about the space of metaphysical possibilities have reasons to maintain that each momentary object exists for exactly one instant. On the other hand, the alternative option is favoured by parsimony considerations: as long as no change occurs to an object, that object has only one stage. With this in mind, the furniture of momentary objects posited by this view is the one strictly sufficient to avoid the commitment to objects hosting contradictory properties. The resulting ontology is strictly adherent to one of the main theoretical motivations underlying Four-Dimensionalism, which is to elude the apparent contradictions related to intrinsic change. Here I am not going to assess which of the two views is more plausible than the others: I only wanted to overview the range of theoretical options that four-dimensionalists are offered by my formulation of the debate.

(5) My formulation of the debate also has the advantage of staying agnostic about the existence of spatiotemporal regions. Both Locational Theory of Persistence and Costa's Transcendentist Theory invoke the concept of location: therefore, they are committed to spacetime substantivalism, because they need spacetime regions as *relata* of the location relation. This is an undesirable outcome, because, again, whether there are spatiotemporal regions or not does not admit an obvious answer; therefore, no answer should be built into the very formulation of the debate.

By contrast, my approach does not resort to the concept of location at all, so it is not committed to the existence of spatiotemporal regions. Of course, it is committed to the existence of stages, but the existence of stages alone does not entail the existence of spatiotemporal regions: those stages might merely entertain spatiotemporal relations with each other, without occupying regions. My way to frame the debate leaves both endurance theorists and four-dimensionalists free to choose between a substantivalist and a relational view of spacetime.

(6) My way to phrase the debate has the virtue of staying neutral about temporal ontology – namely, about whether the most comprehensive domain of quantification includes only present objects, or also past and future objects. For a while, it has been the standard view that the only temporal ontology compatible with Endurance Theory was Presentism⁸, which is the view that the most comprehensive domain of quantification includes only present objects – namely, objects that do exist now. On the contrary, in the last couple of decades, metaphysicians have come to consider a version of Endurance Theory known as the *Saint Theory of Persistence*, which is the view that persisting objects are multiply located across the temporal axis⁹.

The Locational Theory of Persistence can accommodate Saint Theory, but only at the cost of not being neutral about temporal ontology: indeed, it entails the existence of past and future spatiotemporal regions, together with past and future objects – namely, objects that are not present now. By contrast, my way to frame the debate can accommodate Saint Theory, but it can accommodate presentist versions of Endurance Theory as well.

⁸ See, for instance, Merricks 1999.

⁹ The Saint Theory of Persistence was first considered by Gilmore (2004, 2006). It is called that way after the Christian stories about saints being present in different places at the same time.

(7) Finally, a major virtue of my framework is its fairness to both the sides of the debate. By contrast with Costa's Transcendentist Theory of Persistence, my framework alone does not offer any case against one of the two sides over the other: the debate is framed without being adjudicated, and whether Endurance Theory is true or Four-Dimensionalism is true remains an open question. Needless to say, my evidence for this virtue is merely negative: it is just my inability to think of a way my framework alone might entail one of the two views instead of the other. If somebody manages to find such a way, this alleged virtue of my framework can be questioned. In the meanwhile, I take this to be an advantage of my framework.

4. Accommodating the Hard Cases

In the previous section, I have shown the virtues of my framework at accommodating the standard versions of Endurance Theory and Four-Dimensionalism. In this section, I will show how my way of framing the debate can handle certain hard cases – namely, cases of theories that are in the same business as Endurance Theory and Four-Dimensionalism yet are hard to put in one of the two cohorts. In particular, I will be concerned with Brogaard's Presentist Four-Dimensionalism (2000) and with Parsons's "Four-Dimensionalism without temporal parts" (2000). I will argue that the verdict delivered by my framework in these two cases is the right one, so my framework passes even this test.

As I have already stressed, my formulation of the debate has the virtue of staying neutral about the existence of past and future objects: an endurance theorist can accept my formulation of the debate and nevertheless be committed to eternalism. Likewise, one might be committed to a presentist version of Four-Dimensionalism: only present objects exist; those objects have never existed in the past and will never exist in the future anymore, so they are momentary, because the present is unextended. On the other hand, past stages of present objects existed, and future stages of them will exist as well. This view has been actually defended by Brogaard (2000) and I do not find it obviously false. With this in mind, I am going to give it a legitimate – though minor – place in the theoretical landscape.

With this in mind, does this view qualify as a version of Four-Dimensionalism, after all? Indeed, one of the most common – though admittedly approximate and quick – ways to phrase Four-Dimensionalism is to state it as "... roughly ... the doctrine that temporally extended things divide into temporal parts" (Sider 1996: 434). Whatever that means, it

seems to contain an implicit commitment to the rejection of Presentism: if only one time – the present – exists, then no object is temporally extended.

One might argue that, at a closer look, my framework rules out Presentist Four-Dimensionalism from the start: if there are only present objects, then there are no past or future stages. Nevertheless, Presentist Four-Dimensionalism might be made incompatible with my framework by invoking a heterodox view of relational properties: in particular, one might maintain that a present object can have relational properties involving past objects that do not exist anymore or future objects that do not exist yet. The reservations against this view are obvious: a relational property involves a relation with another object, so it cannot be exemplified unless that object exists presently; if Napoleon does not exist, one cannot have the property of *being married to Napoleon*. Actually, advocates of Presentism have defended claims that are close in spirit to this heterodox view of relational properties: for instance, Tallant and Ingram (2015) have tried to solve the truth-maker problem for Presentism by attributing to the world properties concerning the past, such as *having contained Caesar*. In the same spirit, a presentist might maintain that relational properties such as *being married to Napoleon* or *being an ancestor of the 100th president of the USA* can be exemplified by present objects, even if the second *relatum* involved in the relation either does not exist anymore or does not exist yet. With this in mind, one might endorse Presentist Four-Dimensionalism and maintain that present stages do have relational properties involving past and future objects, even though those do not exist anymore or do not exist yet.

As one can easily see, my formulation of Four-Dimensionalism does not rule out this option: I take this theoretical liberalism to be a virtue of my formulation. But something potentially more controversial is also true: according to my formulation of the debate, this view qualifies as a version of Four-Dimensionalism, because it maintains that objects have incompatible properties only as relational properties. According to Sider's characterization of Four-Dimensionalism (1996: 434), this is the wrong verdict, because this view entails that objects are not extended over time. Nevertheless, I contend that mine is the right verdict: this view rightfully qualifies as a version of Four-Dimensionalism, since it shares a certain view of change, which is the mark of Four-Dimensionalism as opposed to Endurance Theory.

The apparent problem with this verdict comes from the use of "Four-Dimensionalism" to refer to the disjunction of Perdurant Theory and Exdurant Theory. Actually, the very phrase "Four-Dimensionalism" evokes the picture of a timeless arrangement of objects

across spacetime: indeed, this nomenclature was adopted when the debate about persistence had not been separated from the debate about temporal ontology. With this in mind, I suggest that it is time to get rid of that nomenclature together with the confusion from which it originated. The phrase “Stage Theory” is normally used as a synonym of “Exdurance Theory”, but it would rather be an appropriate name for both Perdurance Theory and Exdurance Theory, given that both of them posit stages as the pivotal theoretical items to account for change. To put it in a different way, “Stage Theory” should be used for the view that in section 3 I have stated as *Stage Principle*. Stage Theory so defined comes in two main varieties – namely, Perdurance Theory and Exdurance Theory. Those two varieties differ when it comes to the mereological relationship between an object and its stages: Perdurance Theory is that version of Stage Theory according to which the stages of an object *a* are proper parts of *a*; Exdurance Theory is the version of Stage Theory according to which the stages of *a* are not part of *a*. In the remaining part of the chapter, I will be using this revised terminology.

The second hard case is offered by a view that has been explored by Parsons (2000): according to this view, objects are extended over time though they have no temporal parts. As in the case of Presentist Four-Dimensionalism, I do not find this view obviously false, so I want to give it a legitimate place in the space of theoretical options. What is problematic for the framework that I am defending, is that Parsons presents this view as a version of Four-Dimensionalism: in particular, a version of Four-Dimensionalism without temporal parts. As one can easily see, Parsons’s diagnosis is in straightforward contradiction with my account of the debate, because I am claiming that the postulation of stages is the mark of Four-Dimensionalism as opposed to Endurance Theory: if I am right, a theory that is not committed to stages does not qualify as a version of Four-Dimensionalism. On the other hand, the Locational Theory of Persistence can accommodate Parsons’s diagnosis in a straightforward way: according to the Locational Theory of Persistence, this view qualifies as a version of Four-Dimensionalism, because it states that ordinary objects exactly occupy non-instantaneous spatiotemporal regions.

To be sure, this view is different from the standard versions of Stage Theory, but it is also different from standard versions of Endurance Theory. One might think that how we classify such anomalous views is only a matter of stipulation. I suggest that, even when we are concerned with the classification of theories, we should not think that all classifications are created equal. In first-order metaphysics, it is a common view that some classifications

are not merely a matter of stipulation or convention, and that there are things like natural kinds: an objective similarity obtains between the objects that belong to the same natural kind, so a classification that puts them together is preferable to one that does not, because it carves nature at its joints. Likewise, when doing meta-metaphysics – construed as the classification and framing of metaphysical theories – it is reasonable to assume that some theories objectively resemble each other, and this should be the criterion according to which we put two theories under the same label.

Given these assumptions, I want to argue that the view elaborated by Parsons is to be classified as a version of Endurance Theory, because it resembles paradigmatic cases of Endurance Theory in the relevant respect. The strategy proposed by Parsons for eluding the paradoxes of change is to invoke temporally indexed properties, properties such as *being-hot-at-t*: those properties contain a temporal determination and, nevertheless, they are intrinsic, non-relational properties, despite their apparently relational form¹⁰. It is easy to see the similarity between this solution and the solution standardly proposed by endurance theorists: the underlying strategy is to build within properties the temporal qualifications needed to elude the apparent contradictions involved by change. Indeed, Parsons himself acknowledges that he is outlining a kind of analysis commonly offered by endurance theorists (2000: 408). By contrast, the strategy endorsed by perdurance theorists and exdurance theorists is to invoke stages: a stage, because of its short-lived existence/location, is uniquely indexed to a time. To posit stages is, so to say, a way to build temporal qualifications into objects themselves.

To summarise, the view explored by Parsons resembles standard versions of Endurance Theory in a certain respect, and standard versions of Stage Theory in other respects: with this in mind, why should we classify it as belonging to one of those families instead of the other? I maintain that the respect in which it resembles instances of Endurance Theory is more relevant. The rationale behind a philosophical theory is to solve a certain problem: in this chapter, I have argued that Endurance Theory and Stage Theory are best viewed as competing ways to solve the problem of change; a certain strategy to solve that problem is what makes a given view a version of Endurance Theory rather than a version of Stage Theory, or *vice versa*.

The view explored by Parsons shares the strategy to accommodate change that is the mark of all the versions of Endurance Theory: therefore, that is the cohort in which we

¹⁰ In particular, Parsons argues that they are to be analysed as disjunctive properties (2000).

should put it. It is worth stressing that this is also the verdict delivered by Sider's proto-theoretical characterization of Four-Dimensionalism as "... roughly ... the doctrine that temporally extended things divide into temporal parts" (1996: 434). Again, I take this convergence as evidence that my way to frame the debate gets the spirit of Four-Dimensionalism right.

Some final words are needed to address a more general worry about my proposal. If – as I maintain – the crux of the debate between Endurance Theory and Four-Dimensionalism is change, one might wonder why metaphysicians have never considered the framework that I am putting forward. My suggestion is that this is one of those cases when philosophers have given words too much weight. In particular, metaphysicians have stuck to the word "persistence" to understand what was at stake in the debate. Endurance Theory, Perdurant Theory, and Exdurant Theory have been labelled as "theories of persistence" and, in general, it has become customary to describe the debate between Endurance Theory and Four-Dimensionalism as a debate about persistence. For instance, according to Jackson, "The dispute between three-dimensionalism and four-dimensionalism [...] concerns what persistence, and correlatively, what change, comes to" (1998: 138). With this in mind, it is not surprising that metaphysicians have focused on the concept of persistence and on the cognate concepts of presence-at-a-time and (spatio-)temporal location to frame the debate: this looked like the obvious strategy. Against this approach, I suggest that the order taken for granted by Jackson is to be reversed: the dispute between endurance theorists and four-dimensionalists concerns what change, and correlatively, what persistence, comes to. In the next section, I will argue that the questions about persistence – if they are interesting at all – are to be postponed to a later stage of our theorizing about time and related issues.

5. Persistence Again

So, what about persistence? What is for an object to be present/located at a time t ? I suggest that, at the end of the day, this question might be uninteresting. To put it in a different way, it is not obvious that it is interesting. In the previous sections, I have argued that what

motivates Endurance Theory and Stage Theory is the attempt to solve the problem of change, and that both views are best formulated without invoking the concepts of presence-at-a-time or (spatio-)temporal location. If one is happy with my way of framing the debate, it is not clear whether the concept of temporal location plays any useful theoretical role any more.

That being said, I grant that, once one has embedded either Endurance Theory or Stage Theory within a more comprehensive picture of time and change, the concept of location might find some other theoretical utility. For instance, let us consider a substantivalist view of spacetime – namely, the view according to which there are entities such as spatiotemporal regions and the spatiotemporal manifold that is made up of them. Again, let us suppose that the dispute between Endurance Theory and Stage Theory has been settled, so we have accepted one of the two theories over the other: as a result, we are committed to a concrete ontology of persisting objects and spatiotemporal regions. Within this ontology, one might have reasons to ask where those objects are located in the spacetime: needless to say, such a question would require the concept of spatiotemporal location/presence to be asked – and answered as well. What I want to stress here is that those questions – if they are interesting at all – are to be postponed to a later stage, a stage when we are already considering the conjunction of either Endurance Theory or Stage Theory together with other metaphysical views.

I do not even exclude that those issues could have a retroactive relevance to the dispute between Endurance Theory and Stage Theory: in particular, it might be that the suitability to answer such questions offers a case for or against a certain combination of views. For instance, Gilmore (2006) has argued that the question “Where are objects in the relativistic spacetime?” has no plausible answer given the conjunction of Endurance Theory and spacetime substantivalism¹¹. With this in mind, if you are married to spacetime substantivalism, then Gilmore’s arguments might give you reasons to reject Endurance Theory. I grant that this might be put forward as a case against the conjunction of spacetime substantivalism and Endurance Theory and, indirectly, against Endurance Theory *per se*. That being said, this would only be another case of (alleged) *reductio ad absurdum* of a philosophical view – namely, a case in which we conclude that a view or claim is false because it has

¹¹ Gilmore brings out what he calls *Location Question* – namely, the question of what general principle determines ‘... for any given material object, which subregions of that object’s path are exactly occupied by the object’ (2006: 208). Then, he takes the Saint Theory of Persistence as the best regimentation of Endurance Theory and considers the plausible candidates as the answer to the Location Question for the Saint Theory of Persistence within a relativistic framework. Finally, he argues that all those candidates are problematic, concluding that this counts as a case against Endurance Theory.

false implications. But those implications are still logically posterior to the view that they are entailed by. With this in mind, I still maintain that the questions about change are prior to the questions about persistence and spatiotemporal location, even though those might still have weight in the adjudication of the debate.

Chapter 2. Endurance Theory, Dispositions, and the Argument from Temporary Intrinsic

Introduction

According to the formulation of Endurance Theory that I have proposed in chapter 1, Endurance Theory is the view that ordinary objects host incompatible properties directly, not as relational properties involving other objects. With this in mind, the only way endurance theorists can avoid contradictions is to maintain that ordinary objects exemplify those properties only under some temporal qualifications: to maintain that an object a is F and G – with F and G being incompatible properties – would be a straightforward contradiction. The only way to avoid such contradictions is to plug in temporal qualifications: a is F at a certain time and G at some other time. What is the best way to analyse those temporal qualifications is controversial, but it is not controversial that endurance theorists need them. Even if endurance theorists prefer a formulation of their view different from the one that I have proposed, they still need to invoke temporal qualifications, because they cannot adopt the strategy available to four-dimensionalists – which is to build temporal qualifications into the temporal stages of ordinary objects.

Among the incompatible properties exemplified by objects at different times, there are some that are intrinsic. Though hard to define in a rigorous way, the concept of intrinsicness is intuitively clear enough: an intrinsic property is a property that an object has only because of the way that very object is, whereas “the extrinsic properties of something may depend, wholly or partly, on something else” (Lewis 1983: 197). I will call those intrinsic properties that objects exemplify with respect to times *temporary intrinsics*. Defenders of four-dimensionalism have sometimes suggested that endurantists are forced to endorse so-called Relationism, according to which temporary intrinsics are, properly speaking, two-place relations holding between objects and times: for instance, Socrates being white at a certain time consists in Socrates having a certain relation with that time¹². As a matter of fact, virtually no defender of Endurance Theory has openly embraced

¹²This diagnosis of the problem faced by Endurance Theory in accommodating temporary intrinsics was first made by Lewis (1986a).

Relationism, and some metaphysicians have proposed less revisionary treatments, such as Adverbialism and Sententialism¹³.

Whatever strategy one prefers, the need for temporal qualifications is considered to be an undesirable consequence of Endurance Theory, since intrinsic properties seem to be exemplified *simpliciter* by objects. On the other hand, it is argued that Perdurant Theory and Exdurant Theory preserve this intuition, because they maintain that incompatible temporary intrinsics are exemplified by distinct momentary objects, which have those properties *simpliciter*.¹⁴ Actually, on closer inspection, there is a substantial difference between these two versions of Four-Dimensionalism when they come to deal with temporary intrinsics. Exdurant Theory, which identifies ordinary objects with momentary objects, entails that they have intrinsic properties *simpliciter*. For instance, according to Exdurant Theory, I myself am a momentary object, and I have whiteness *simpliciter*. By contrast, Perdurant Theory offers a less direct account of temporary intrinsics, since it identifies ordinary objects with certain mereological sums of momentary objects. Let us consider again the example above: even if there is an object intimately related with me that is white *simpliciter*, that object is not me, but a (proper) temporal part of me. I can be said to be white only in a derivative way, in so far as my present momentary stage is white. Ultimately, Exdurant Theory seems to be the only account of change in the market which preserves the intuition that intrinsic properties are exemplified by ordinary objects *simpliciter*: For this reason, Sider has correctly pointed out that this line of reasoning, if successful at all, supports Exdurant Theory rather than Perdurant Theory (Sider 2000; 2001: 92-8). In what follows, I will call this line of reasoning *Argument from Temporary Intrinsics*, and I will show that, on closer inspection, not even Exdurant Theory can be defended by invoking it.

¹³See, among others, Haslanger 1989 for a defence of Adverbialism and Oderberg 2004 for a defence of Sententialism. Both the strategies were originally suggested by Lowe (1988). Four-dimensionalists have sometimes argued that those alternatives actually amount to Relationism in disguise: according to Sider “... such circumvention accomplishes little” (2001: 96); a criticism along the same lines has been also made by Hinchliff (1996).

¹⁴The concept of exemplification *simpliciter*, i.e. absolutely, or with no qualifications, seems to be taken as fundamental and irreducible by four-dimensionalists. It is questionable whether such a concept is clear enough to be taken as undefined, but in this chapter, I will concede that it is, at least for the sake of argumentation.

1. The Status of Momentariness

As we have seen, exdurance theorists claim to avoid the problem of temporary intrinsics by identifying ordinary objects with momentary objects, objects existing for exactly one instant, or at least for a “brief enough” time. That being said, what are instants, and how brief is brief enough? Perhaps the most obvious idea is to invoke times lacking temporal extension: an instant is a point-like time or, to put it in quasi-mereological terms, a time having no proper sub-interval. However, issues concerning the extension of times are not directly relevant here: what matters is that for exdurance theorists who appeal to the argument we are examining, momentary objects are called upon to play a certain theoretical role, which is to provide a domain of objects that exemplify properties with no temporal qualification. In order to satisfy this requirement, they must exist for a time which does not leave room for change. For present purposes, I will define an instant as a time when change is metaphysically impossible¹⁵. Indeed, this concept of an instant is likely to be modally – though not conceptually – equivalent to the duration-based one: intuitively, if a time allows for change then it must have proper sub-intervals and, *vice versa*, if a time has proper sub-intervals then it can host a succession of states. However, I will not discuss the relationship between these two concepts further.

That an instant, in the sense established above, is a time that is too brief for change can be regarded as an analytic truth based on a stipulation. The point is that this is the right sort of stipulation here, because it helps to describe the picture that exdurance theorists must endorse in order to offer a solution to the problem of temporary intrinsics. According to Exdurance Theory, an ordinary object is momentary, hence it can undergo qualitative change only by having temporal counterparts (i. e. momentary objects that have an appropriate continuity with it) with different qualities from it, local change only by having temporal counterparts that occupy different places from it, and so on. In what follows, I will talk about *ontic change* in regard to an object coming into being or passing away, whereas I will talk about *alteration* in a broad sense to refer to any other kind of change, be

¹⁵The appeal to metaphysical impossibility instead of weaker kinds of impossibility is required to elude certain counter-examples. For instance, let us consider a world *w* where, at time *t*, all energy has been dissipated and the temperature reaches absolute zero: it seems that no change can occur in the time after *t* and, nonetheless, there is no sense in which that time can be said to be an instant. The point is that change in the time after *t* is only historically impossible, since every possible world that has the same laws as *w* and is exactly alike *w* up to *t* does not host any change after *t*. Nonetheless, there are possible worlds where things go in a different way and something happens after *t*; thus, such time does not qualify as an instant according to the present definition.

it qualitative, relational, local or whatever. Given this terminology, one can say that, generally, within Exdurance Theory, ordinary objects can undergo alterations only by having temporal counterparts with appropriate features.

What is the modal status of the momentariness of ordinary objects? The first answer available is that they are necessarily momentary, that is to say, they exist for exactly one instant at every possible world where they exist (or have a modal counterpart) at all. The second option is that ordinary objects are momentary only contingently: as a matter of fact, they exist just for an instant, but they could have endured, i.e. they could have existed for a non-instantaneous time, which is, according to our definition, a time change can occur at. Therefore, they could have undergone change directly, by having contradictory features under temporal qualifications. According to this version of Exdurance Theory, not only it is metaphysically possible that there are enduring objects, but the actual ordinary objects themselves might endure.

As far as we are concerned here, the problem with the contingent version of Exdurance Theory is that it would make the Argument from Temporary Intrinsic inconclusive. As we have seen, that an object has incompatible intrinsic properties under certain temporal qualifications is considered to be problematic because intrinsic properties should be exemplified *simpliciter*. Exdurance Theory, in its non-contingent formulations, is supposed to solve this problem by claiming that temporary intrinsics are exemplified by objects that cannot have incompatible properties. On the other hand, the contingent version of Exdurance Theory, at the most, might claim to solve the problem of temporary intrinsics by assuming that, as a merely contingent matter of fact, all ordinary objects exist for a time that is too brief for change, so none of them has incompatible properties. Such a claim does not address the problem at all, but it simply confines instances of the problem to merely possible worlds. To use an analogy, suppose that someone suggests solving the grandfather paradox by assuming that, as a merely contingent matter of fact, no backward time travel occurs in the actual world, so no instance of paradoxical backward causation occurs: such a move does not provide an answer to any philosophical worry, because here, as in the case of temporary intrinsics, the problem is represented by the very metaphysical possibility of events or state of affairs of a certain kind, not by the epistemic possibility that those actually occur.

To summarise, a version of Exdurance Theory that claims that (actual) ordinary objects are momentary only contingently is not supported by the Argument from Temporary Intrinsic. In what follows I will discuss the necessitarian version of Exdurance Theory

saying that (actual) ordinary objects are necessarily momentary¹⁶, in order to assess whether, all things considered, this version can be supported by the Argument from Temporary Intrinsic. I will argue that it cannot, because of certain problems in accommodating dispositional properties.

2. Stages and Dispositions

The manifestation of a disposition typically involves an alteration in the object having that disposition: mass, charge, solubility and fragility are examples of such dispositions. To be sure, the manifestation of some dispositions employed in scientific explanation involves, among other things, that the object undergoes ontic change by passing away: for instance, a water-soluble sodium chloride crystal (arguably) passes away by dissolving in water. Nevertheless, even those dispositions involve certain alterations that cause the ontic change: in the present case, the salt crystal passing away is caused by alterations in the bonds between its constituent atoms.

In section 2, we have seen that those exdurance theorists who appeal to the Argument from Temporary Intrinsic must maintain that ordinary objects exist for a time when change is metaphysically impossible: since they are (necessarily) too short-lived, they can undergo alterations only by having later counterparts with appropriate features¹⁷. For instance, an object manifesting its mass will involve its later counterparts occupying in succession a certain spatiotemporal path, whereas an object manifesting its fragility will involve its temporal counterparts having certain intrinsic properties.

One might try to avoid this analysis of dispositions in terms of temporal counterparts by embracing a contingent version of Exdurance Theory: even if actual ordinary objects exist for exactly one instant, they could endure and undergo alterations directly, by having incompatible properties under temporal qualifications. Unfortunately, this option is not available here: as we have seen above, exdurance theorists cannot appeal to the Argument from Temporary Intrinsic without maintaining that actual ordinary objects are necessarily momentary.

¹⁶It is worth noticing that this version of Exdurance Theory does not entail that endurance is impossible at all: it may be the case that in some merely possible world there are alien objects (i.e. objects that do not exist in the actual world) that endure. However, this possibility is not relevant to the present discussion.

¹⁷At a first look, this seems to obtain only for later counterparts, unless one admits the metaphysical possibility of some sort of backward causation. For the sake of simplicity, I will bracket the issue of backward causation, and I will talk only about later counterparts.

That being said, necessitarian exdurance theorists might claim that momentary objects are disposed to undergo intrinsic change by having incompatible properties under temporal qualifications, although it is impossible that such change occurs, since they are necessarily momentary. *Prima facie*, this option sounds absurd, because every disposition involves a power; indeed, one is tempted to say that a disposition just is a power, so it seems that having a disposition entails the capability of manifesting it. Actually, Jenkins and Nolan (2012) have argued that certain objects have dispositions that they cannot manifest: their most compelling case concerns certain dispositions of agents, such as the disposition to be surprised when seeing a round square object, which cannot be manifested because of the impossibility of such objects. Though unmanifestable, such dispositions can help us explain the behaviour and the emotional states of agents. Likewise, necessitarian exdurance theorists might claim that momentary objects have dispositions that they cannot manifest – although those dispositions are manifestable in possible worlds where they are borne by enduring objects.

My reply is that, even if we grant that there are objects with unmanifestable dispositions, maintaining that all dispositions are unmanifestable goes too far: if all dispositions are unmanifestable and thus, *a fortiori*, unmanifested, no event can be explained in terms of objects manifesting dispositions, but this is the explanatory model actually employed by science. Furthermore, even if some unmanifestable dispositions, like that of agents, might be explanatory, it is hard to see what explanatory role might be played by dispositions that cannot be manifested because the objects having them are (necessarily) too short-lived. Overall, dispositions of that kind would be just redundant: they are not suited to play their standard causal/ explanatory role, and they are unlikely to occupy an alternative role. In conclusion, the appeal to the possibility of unmanifestable dispositions does not help necessitarian exdurance theorists to defend the present view.

To summarise, within a necessitarian exdurance-theoretic framework, the manifestation of the dispositions of ordinary objects cannot consist in having contradictory properties under temporal qualifications, because their being necessarily momentary prevents them from that: necessitarian exdurance theorists must accept that ordinary objects manifesting dispositions involves their later counterparts having certain properties.

Given that exdurance theorists must acknowledge that momentary objects are disposed to affect their later counterparts, one still has to assess how they are so disposed. It seems that there are two possibilities here: the first option is that their dispositions are rigid relational properties they entertain with their later counterparts; the alternative is that those

dispositions are qualitative properties and that an ordinary object being disposed to affect its later counterparts does not consist in that object entertaining a rigid relation with them. I will show that here Necessitarian Exdurance Theory faces a dilemma, since in either case it cannot be defended by the Argument from Temporary Intrinsic.

3. The First Horn: Relational Dispositions

According to the first option, a disposition of an ordinary object *a* consists, among other things, in making b_1, \dots, b_n have certain features under certain conditions, where b_1, \dots, b_n are the (actual) later counterparts of *a*, and such a disposition is a rigid relational property that *a* entertains with the very same objects in all the possible worlds in which it has that disposition at all. It follows from this view that dispositions are extrinsic properties: in a world where *a* has no later counterparts, it has not the power to affect the features of b_1, \dots, b_n , even if it has the same intrinsic features it has in the actual world. These implications seem to make the Argument from Temporary Intrinsic fail: exdurance theorists cannot claim any more that their view of intrinsicness is less revisionary than that required by Endurance Theory.

The most natural response to this difficulty is that the extrinsicness of dispositions is not an unwelcome consequence of this option, but a claim that can also be defended on different grounds: actually, Shoemaker (1980) and McKittrick (2003) have argued that some dispositions are extrinsic independently of the debate between Endurance Theory and Four-Dimensionalism. For instance, the disposition to open my (actual) front door is a rigid relational property that my key entertains with another object (which is mereologically disjoint from it): if the lock of my front door undergoes deformation, my key loses the power to open it without undergoing any intrinsic change. With this in mind, one might reply that the first horn of the dilemma raises no difficulty, since at the end of the day it requires no further revision of our intuitions about intrinsicness/ extrinsicness than what we already have reasons to accept. My rejoinder is that, in fact, this horn greatly enlarges the scope of the revision: outside Exdurance Theory, the Shoemaker-McKittrick argument applies only to dispositions which are obviously external rigid relational properties, like the case seen above, whereas the horn that we are examining seems to entail that all dispositions ultimately turn out to be so, which clashes with our initial intuitions. Again, here the trouble for exdurance theorists is that, if they embrace these

revisionary perspectives on intrinsicness, they cannot claim any advantage over Endurance Theory in this respect, so the very strategy underlying the argument is flawed.

To sum up, this horn of the dilemma has implications in regard to the intrinsicness/extrinsicness of dispositions that seem to be even more revisionary than the options available to endurance theorists to accommodate temporary intrinsics. As we have seen, the most targetable account available to endurantists is the relational one, according to which, for instance, whiteness is a relation holding between objects and times. Actually, even one who endorses the relational account might still claim the right to consider a temporally indexed property like *being white at t* intrinsic in some non-trivial sense, in so far as it is a rigid relational property that involves only one object: after all, one might adopt an account of intrinsicness maintaining that a time entering or not into a (rigid relational) property is irrelevant for that property being intrinsic or extrinsic. Although this solution might sound artificial, it still helps to single out certain properties as intrinsic and contrast them with extrinsic ones.

By contrast, within a stage-theoretic framework, one cannot rely on any categorial distinction between objects and times (or spatiotemporal regions) to preserve the intrinsicness of dispositions, because those are, at the most, relational properties that involve only objects. Therefore, there is no way to pick up any relevant difference between them and typically extrinsic properties such as *being taller than Napoleon* or *being married*. The defenders of Exdurance Theory can insist that their view is still the most straightforward one at accommodating the *prima facie* intrinsicness of certain temporary purely categorial properties like shapes¹⁸, but even if one grants that those are best accommodated by Exdurance Theory, there is no reason why they should deserve some priority here: indeed, in a scientific worldview dispositions occupy a much more important explanatory role.

4. The Second Horn: Qualitative Dispositions

The alternative is that dispositions like mass or fragility are qualitative properties that do not consist in rigid relations with certain particular objects: an ordinary object *a* with a

¹⁸Actually, even the claim that shapes are intrinsic properties of objects has been called into question on grounds independent from the debate between Endurance Theory and Four-Dimensionalism (McDaniel 2007b, Skow 2007).

disposition like mass or fragility is, among other things, disposed to affect its later counterparts in a certain way, where I am using “its later counterparts” non-rigidly, as applying, in each world w , to those objects that are the later counterparts of a at w . Such dispositions to affect later counterparts are pure properties, since they do not consist in any relation to any particular object: a momentary object that actually has as later counterparts b_1, \dots, b_n has the same disposition even in a world where its later counterparts are b_1', \dots, b_n' (with $b_i \neq b_i'$ for any $1 \leq i \leq n$).

This way of being disposed to affect later counterparts does not seem more problematic than the way in which an object with a mass is disposed to interact with the other objects having a mass, or the way in which a salt crystal is disposed to dissolve in water: an object with a certain mass would be disposed toward certain interactions even if there were no other objects with a mass. Likewise, those dispositions might be borne also by a momentary object with no later counterparts: though not persisting actually, such an object would be nonetheless disposed to produce certain effects under certain conditions. According to the present view, dispositions qualify as intrinsic properties, so the problems faced by the first horn are eluded.

However, even this horn turns out to be troublesome once we have a closer look at what counterparthood is and what it is not. Hawley has convincingly argued that neither qualitative resemblance nor spatiotemporal continuity is sufficient to pick up natural series of stages (2001: 70). Therefore, it seems that some appropriate causal/ counterfactual dependence is needed, which will include a certain sensitivity to dispositions too: being a later temporal counterpart of a will require, among other things, being possibly involved in the manifestation of the dispositions of a , in a way that objects that are not counterparts of a are not. For example, being a temporal counterpart of an object a with fragility will involve having appropriate features provided that a undergoes a suitable stimulus¹⁹. That being said, how can one account for this difference? To put it in another way, what features of the world are responsible for such an exclusive connection between the stages of an ordinary object? It seems that here there are two accounts available: I will show that both of them are problematic.

The first option is that such a connection depends on certain special dispositions: for instance, the later stages of Socrates have a certain passive power that disposes them to be

¹⁹This conditional analysis is, however, just an approximation, as brought out by Martin’s notorious counter-example of finkish dispositions, which shows the inadequacy of the simple counterfactual account of dispositions (Martin 1997).

affected in a certain way by its earlier stages, whereas the later stages of Aristotle have an analogous passive power that disposes them to be affected by the earlier stages of Aristotle, but not by those of Socrates. Actually, according to this view, a momentary object does not simply have a mass, but a distinctive species of mass that disposes it to affect in a certain way its later counterparts, since its later counterparts have a distinctive, complementary passive power that makes them sensitive to that species of mass. These dispositions allow one to select natural series of momentary objects with the appropriate match of causal powers; indeed, according to this proposal “counterparthood” is a catch-all term for a vast family of relations holding between stages causally connected in various ways, since the powers that glue together a series of photon-stages are largely different from those that glue together a series of banana-stages.

The main concern with this view is that there are series whose stages exhibit no qualitative difference suited to ground this difference in dispositions. Let us consider two ordinary objects that look qualitatively indistinguishable at every time they exist: the present framework entails that they actually differ in respect to certain qualities, although they are indistinguishable according to both natural science and common sense. It seems that this solution can account for the internal connection of natural series of stages only at the cost of positing into the world a rich furniture of *ad hoc* properties and related laws.

This strategy might remind one of Tooley’s thought experiment about Smith’s garden: suppose that “... All the fruits in Smith’s garden at any time are apples. When one attempts to take an orange into the garden, it turns into an elephant. Bananas so treated become apples as they cross the boundary, while pears are resisted by a force which cannot be overcome...” (1977: 686), and so on. In such a scenario, we would be compelled to conjecture that Smith’s garden has a special property *P* that, together with a related law of nature, is responsible for those peculiar phenomena. Even if the garden exhibited no further difference from any other garden in the universe, positing *P* would still be the only hypothesis available, no matter how artificial it might sound. Likewise, one might argue that in the case of stages we are compelled to posit certain dispositions to account for the unique dependence that links the stages of the same ordinary object. However, there is a relevant difference between Smith’s garden scenario and the present issue: in the former case we would be facing empirical data that cannot be accounted for in any other way; by contrast, in the case of Exdurance Theory, there are alternative views of change that avoid the postulation of *ad hoc* natural properties. Therefore, this *ad hoc* character qualifies as a peculiar problem faced by Exdurance Theory under the present horn of the dilemma.

Moreover, there is a further worry about the distribution of those dispositional properties. As we have seen, according to the present view stages that are otherwise indistinguishable can have different dispositions, so those dispositions do not supervene on more fundamental properties of stages – unless contemporary science is completely wrong in its inventory of properties. Let us consider an object with a disposition F , whose later stages have the complementary passive power G : if G does not supervene on more fundamental properties, it is possible that there is a momentary object b that belongs to a different kind than a , has no spatiotemporal continuity with a and, nonetheless, has the property G , which makes it a later temporal counterpart of a . If this is possible, why are there no analogous cases in the actual world? Those exdurance theorists who adopt the present view must accept that it is just a cosmic coincidence that in the actual world those coupled dispositions are spread only among momentary objects arranged into kind-homogeneous and spatiotemporally continuous series.

An alternative to the postulation of the *ad hoc* dispositions above is suggested by Hawley (2001: ch. 3), who proposes to take temporal counterparthood as an irreducible, non-supervenient relation holding between certain momentary objects. Such a relation does not consist simply in an appropriate causal/counterfactual dependence, but it is rather the ground of that dependence. If one endorses Hawley's view, one might argue that whether such a relation obtains or not is one of the conditions required for the manifestation of dispositions: to put it briefly, what grounds the difference between the way in which a later stage of Socrates is sensitive to the dispositions of the earlier stages of Socrates and the way in which other objects are, is nothing but the brute fact that the former is a temporal counterpart of Socrates, whereas the others are not. That's all metaphysicians need to say about this issue.

This option has still to face at least two notable difficulties. First, there is a basic objection against taking counterparthood as primitive: exdurance theorists owe us a story, since "temporal counterpart" is a philosophical term of art that requires some explication in order to be informative. To simply claim that such a relation occupies a certain role, for instance by grounding the causal dependence between certain stages, is not sufficient: it is one thing to acknowledge that a certain theoretical/explanatory role is to be played by some concept, another thing is to find a concept suited to play that role.

Second, there are worries about the causal role that this non-supervenient relation is supposed to play, which looks too pervasive: indeed, this relation is supposed to ground any sort of causal/counterfactual dependence between stages of any sort. Therefore,

virtually all dispositions must be twofold in respect to it, since they convey a certain manifestation where the relation obtains, and a different one where the relation does not obtain: for instance, an object manifests its mass affecting in a certain way those objects that are related with it by counterparthood and in another way those objects that are not. Hawley invokes an analogy between this irreducible relation of counterparthood and the irreducible relation posited by Teller (1986) to accommodate quantum entanglement: given that both of them are non-supervenient, the former, she argues, is not more mysterious than the latter (2001: 89). But there is also a deep dissimilarity between the two cases: entanglement is a specific sort of correlation that obtains between objects of certain kinds, whereas, according to the present view, counterparthood concerns all objects, from subatomic particles to multicellular living beings, and it determines the causal behavior of all of them by determining the manifestation of their dispositions. In this respect, Teller's entanglement relation is a typical natural feature, whereas temporal counterparthood is different from any feature with a causal role that we have familiarity with. This peculiarity strengthens the suspicion that introducing such a relation into the fundamental furniture of the world would be an *ad hoc* move: as a hypothesis in philosophy of nature, it is just strained.

In conclusion, it seems that neither the postulation of special dispositions nor the appeal to irreducible counterparthood can help four-dimensionalists to work out a defensible account of dispositions as pure properties of momentary stages. This second horn can be embraced only at a high cost: even if one grants that the resulting version Exdurance Theory is more intuitive than Endurance Theory at accommodating temporary intrinsics, that advantage is undermined by a very implausible account of dispositions.

Summary

Until now I have considered dispositions, such as mass, charge, solubility or fragility, whose manifestation involves alterations in the objects that exemplify them. One could reply that there might be dispositions that do not have this character. For example, consider an object with the disposition to affect the state of other objects – which, within a stage-theoretic framework, are not its counterparts – while ceasing to persist instantaneously – which, within a stage-theoretic framework, amounts to having no later counterpart; such a manifestation would involve no alteration in the object that has the disposition.

I want to stress that I have not claimed that, by necessity, all dispositions have an alterative

character: I concede that (objects with) non-alterative dispositions like that described above may be metaphysically possible, since I see no *prima facie* evidence against their possibility. Likewise, I grant that we cannot rule out *a priori* that in the actual world there are objects with such dispositions. What matters for my argument is that most, if not all, dispositions actually employed in scientific explanations have this alterative character. Given these troubles with dispositions, the most radical response would be to refuse to account for them, or to deny that ordinary objects have dispositional properties at all, but this option is unpalatable, because those properties are an indispensable ingredient of scientific explanation: natural science gives us strong reasons to posit a rich inventory of dispositions, and a metaphysical theory worth considering should accommodate them. One might speculate that a more mature physics will empty our ontological landscape of dispositions²⁰, but, as Blackburn observes, “... any conceivable improvement in science will give us only a better pattern of dispositions and powers” (1990: 63), because physicists study physical objects by observing the way they interact, and the properties that one can detect through this method are dispositional. Therefore, it would be dogmatic to rely on a wish for a dispositions-free science just to retain certain metaphysical prejudices.

Let us summarise the whole line of reasoning of this chapter. First, exdurance theorists cannot claim support from the Argument from Temporary Intrinsic without maintaining that (actual) ordinary objects are necessarily momentary. Regrettably, this necessitarian version of Exdurance Theory faces a dilemma: the first horn delivers a picture of intrinsicness/ extrinsicness that is even more revisionary than the weakest one available to endurantists, which makes the underlying argumentative strategy fail. The second horn allows one to retain an intuitive account of intrinsicness, but only at the cost of a problematic view of causal powers. In either case, the Argument from Temporary Intrinsic cannot be invoked to support Exdurance Theory. Generally, when it comes to accounting for temporary intrinsic, four-dimensionalists cannot claim any advantage over endurance theorists.

²⁰This sort of faith in a forthcoming elimination of dispositions from science was embraced, for instance, by Quine (1969).

Chapter 3. What Place for Dispositions Within Four-Dimensionalism?

Introduction

According to the formulation that I have proposed in chapter 1, Four-Dimensionalism is the view that objects have incompatible properties only as relational properties that involve other objects: this claim flies in the face of the common intuition that objects host incompatible properties directly. Whatever formulation of Four-Dimensionalism one prefers, the view of persistence and change offered by Four-Dimensionalism is, to say the least, revisionary: according to this picture, the world is made up of short-lived, momentary objects and their mereological sums. To put it in a loose but suggestive way, change consists of series of changeless momentary objects related to each other by some appropriate kind of continuity.

The defenders of Four-Dimensionalism tend to acknowledge that their view is revisionary, but they argue that those revisions are the fair price to pay to buy a satisfactory solution to the puzzles of material coincidence and material constitution²¹. They also often claim that this view has the advantage of doing justice to certain alleged intuitions, such as that temporary intrinsics are exemplified by objects *simpliciter*, not just under temporal qualifications as seems to be required by rival theories²². In this chapter, I will show that, even if one grants that Four-Dimensionalism has such advantages over Endurance Theory, the amount of revision that it requires becomes alarming once we take into account a kind of properties that are distinctively related to change and the possibility of change – namely, dispositional properties. As it often happens in metaphysical debates, the need for those revisions alone is not sufficient to provide a definitive case against Four-Dimensionalism, but it shows at least that Four-Dimensionalists need either to do further work or to bite some other bullets. In chapter 2, I have shown that a popular argument for Four-Dimensionalism – the argument from temporary intrinsics – actually fails at supporting any

²¹According to Sider (2001: ch. 5) and Hawley (2001: Ch. 5-6), suitability to solve those puzzles provides the main argument in favour of Four-Dimensionalism over Endurance Theory.

²²The so-called Argument from Temporary Intrinsics was first advanced by Lewis (1986a: 204). See chapter 2 of the present work for a challenge to this argument. For a reconstruction of the place of the argument within Lewis's overall metaphysical system, see Hawley 2015.

version of that view. In this chapter, I present my first main argument in favour of Endurance Theory over Four-Dimensionalism. In chapter 4, will present a further argument.

As in chapter 2, I will be talking about *ontic change* to refer to an object coming into being or passing away, and I will be talking about *alteration* to refer to any other kind of change, be it qualitative, quantitative, relational or local. Given this terminology, the manifestation of a disposition typically involves an alteration in the object that has that disposition: mass, charge, solubility and fragility are examples of such dispositions. To be sure, the manifestation of some dispositions employed in scientific explanation involves, among other things, that the object undergoes ontic change by passing away: arguably, a water-soluble sodium chloride crystal passes away by dissolving in water. Nevertheless, even those dispositions involve certain alterations that cause the ontic change: in the present case, the salt crystal passing away is caused by alterations in the bonds between its constituent atoms.

Within Endurance Theory, the account of dispositions and their manifestation is straightforward: an enduring object undergoes the changes involved in the manifestation of its dispositions just by having incompatible properties at different times. By contrast, things are not so plain with the other accounts of persistence. In chapter 2, it turned out that the Argument from Temporary Intrinsic fails, among other things, because of certain troubles with dispositions. In this chapter, I will argue that, independently from the Argument from Temporary Intrinsic, four-dimensionalists face more general problems when it comes to dispositions, since they have a hard time finding a place for them within their ontology.

1. Momentary Stages and Dispositions

Generally, Four-dimensionalism can be stated as “roughly... the doctrine that temporally extended things divide into temporal parts” (Sider 1996: 434). As I have already illustrated in chapters 1 and 2, two four-dimensionalist accounts of persistence have been defended in the contemporary debate: the first one is Perdurance Theory, which states that persisting objects are present at different times by having as proper parts momentary stages that exist at different instants. The other one is Exdurance Theory, which directly identifies ordinary objects with momentary objects. As Hawley (2001) observes, both of those views need the

concept of counterparthood to distinguish natural series of stages from gerrymandered ones: for example, distinct momentary stages of Socrates are related by counterparthood, whereas a banana-stage and a cat-stage are not. The difference, again, is that according to Perdurant Theory an ordinary object is identical to a natural series – or, to be more rigorous, to the mereological sum of the members of a natural series – whereas according to Exdurant Theory an ordinary object is one of the members of a natural series, and it is vicariously present at other times in so far as it is represented by other members of the series.

Likewise, momentary objects figure in both Perdurant Theory and Exdurant Theory, though in different theoretical roles. With this in mind, what is the modal status of the momentariness of those objects? In chapter 2, we have seen that there are two possible answers: the first answer is that they are necessarily momentary, that is to say, they exist for exactly one instant at every possible world where they exist (or have a modal counterpart) at all. The second answer is that momentary objects are momentary only contingently: as a matter of fact, they exist for only one instant, but they could have endured, i.e. they could have existed for a non-instantaneous time, a time when change can occur. Therefore, they could have undergone change directly, by having contradictory features under temporal qualifications. In what follows, I will use *Necessitarian Four-Dimensionalism* as a shorthand for the first view and *Contingentist Four-Dimensionalism* as a shorthand for the second view.

With the distinction above in mind, there are various ways one can try to accommodate dispositions within a four-dimensional ontology. I will now show that no matter whether one prefers Necessitarian or Contingentist Four-Dimensionalism, the only viable option is to maintain that an ordinary persisting object manifesting a disposition at a certain time involves its later stages having certain properties. I will proceed by elimination, showing that the alternative views are non-starters.

First, one might endorse Necessitarian Four-Dimensionalism and claim that momentary objects are disposed to undergo intrinsic change by having contradictory properties under temporal qualifications, although it is impossible that such a change occurs since they are necessarily momentary. The straightforward account of dispositions available to endurance theorists is available here as well, but with one paramount difference: four-dimensionalists who endorse the present view would have to maintain that momentary objects cannot manifest their dispositions. In chapter 2, we have seen that, even though this view sounds absurd, it has been argued that some objects have dispositions that they cannot manifest

(Jenkins and Nolan 2012). Nevertheless, maintaining that all dispositions are that way goes too far: if all dispositions are unmanifestable and thus, *a fortiori*, unmanifested, no event can be explained in terms of objects manifesting dispositions, but this is an explanatory model that both science and common sense cannot dispense with. With this in mind, the appeal to the possibility of unmanifestable dispositions does not help necessitarian endurance theorists to defend the view that momentary objects are disposed to undergo intrinsic change by having contradictory properties under temporal qualifications.

In conclusion, it seems that, if momentary objects are necessarily momentary, then they can manifest dispositions only by having later counterparts with appropriate features. Likewise, a series can manifest dispositions only by having later members with the appropriate features²³. For instance, an object manifesting its mass will involve its later counterparts occupying in succession a certain spatiotemporal path, whereas an object manifesting its fragility will involve its temporal counterparts having certain intrinsic properties.

One might try to escape this analysis of dispositions in terms of temporal counterparts by embracing Contingentist Four-Dimensionalism: even if actual ordinary objects exist for exactly one instant, they could endure and undergo alterations directly, by having contradictory properties under temporal qualifications. The account is exactly the same as that provided by Endurance Theory, but, according to the present view, as a matter of fact, no disposition is ever manifested, since no object endures. At a closer look, it is easy to see why this strategy is a non-starter: if no disposition is ever manifested, no actual event is due to the manifestation of a disposition. Therefore, there is no reason to posit dispositions at all, since they are explanatorily redundant. Even those who prefer Contingentist Four-Dimensionalism cannot endorse the view that persisting objects manifest their dispositions by having contradictory properties at different times.

In conclusion, no matter whether they prefer Necessitarian Four-Dimensionalism or Contingentist Four-Dimensionalism, four-dimensionalists must maintain that an ordinary persisting object manifesting a disposition at a certain time involves its later stages having certain properties. Given that they have to acknowledge that momentary objects are disposed to affect their later counterparts, one still has to assess *how* they are so disposed. Here there are two possibilities, which can be contrasted with each other by invoking the

²³At a first look, this seems to obtain only for later counterparts, unless one admits the metaphysical possibility of some sort of backward causation. For the sake of simplicity, I will put the issue of backward causation aside, and I will be concerned only with later counterparts.

distinction between pure and impure properties.

A property is impure if and only if it involves relations with certain objects: examples of impure properties are *being married to Henry VIII* or *being taller than Napoleon*. A property is pure if and only if it is not impure. It is worth noticing that a property can be relational and nonetheless pure: for instance, *being married to some man* is relational and pure, because it does not involve any relation to any particular object, whereas *being married to Henry VIII* is impure. With this distinction in mind, the first option to consider here is that the disposition of a momentary object to affect its later counterparts in a certain way is a pure property. The alternative is that those dispositions are impure properties, which involve certain relations with their (actual) later counterparts in particular. In what follows, I will explore the possible developments offered by these two options.

2. Dispositional Relations

One option available to four-dimensionalists is to maintain that a momentary object a with a disposition like mass or fragility is, among other things, disposed to affect its later counterparts in a certain way, where I am using ‘its later counterparts’ non-rigidly, as applying, in each world w , to the objects which are the later counterparts of a at w . As I have already shown in chapter 2, this strategy can be worked out either by invoking special dispositions or by invoking an irreducible counterparthood relation: sadly, both the strategies ultimately fail. The only alternative left is the view that dispositions are impure.

According to this alternative option, a disposition of a momentary object a consists, among other things, in making b_1, \dots, b_n have certain features under certain conditions, where b_1, \dots, b_n are the (actual) later counterparts of a , and such a disposition is an impure property involving a relation with b_1, \dots, b_n in particular. According to an endurance theorist who adopts this strategy, dispositions are extrinsic properties: in a world where a has no later counterparts, it does not have the power to affect the features of b_1, \dots, b_n , even if it has the same intrinsic properties it has in the actual world. According to a perdurance theorist who adopts this strategy, dispositions are historical properties: a perduring object having a disposition at t depends on how that object is at times other than t .

Is the view that dispositions are extrinsic properties implausible? As we have seen in chapter 2, the quickest response is that this is not an unwelcome consequence of this approach, but a view which can be defended on other grounds as well: actually, Shoemaker

(1980) and McKittrick (2003) have argued that some dispositions are extrinsic independently of the debate on persistence. My rejoinder was that, even if one accepts their claim, the view that *all* dispositions are extrinsic is much stronger than that: on its own, the Shoemaker-McKittrick argument applies only to certain special dispositions that are obviously impure and extrinsic (see chapter 2, section 3), whereas the view that all dispositions are impure and extrinsic is highly revisionary. Once combined with such a view of dispositions, Perdurant Theory is not better off than Endurance Theory: a perduring object has a mass at time *t* in virtue of the relation between its stage at *t* and later stages. Within such a framework, dispositions are historical properties that objects have at a certain time *t* also in virtue of the way they are at later times.

That being said, here four-dimensionalists are likely to bite the bullet with few tears: it is already a widely accepted view among endurance theorists that many seemingly intrinsic properties actually are extrinsic properties that momentary objects have because of their relations with their temporal counterparts. For instance, Sider has embraced this view about mental properties such as *having a belief* (1996: 449), and Hawley has embraced a similar view about sortal properties: within Endurance Theory, a momentary object is a banana if and only if its temporal counterparts have the appropriate features (2001: 53-4). With this in mind, they might just add dispositions to that list. As I have stressed in chapter 2, those who endorse such a move cannot claim anymore that their account of temporary intrinsics is less revisionary than that offered by Endurance Theory. That being said, four-dimensionalists might accept that and embrace this relational view as a defensible strategy to accommodate dispositions within their ontology. In what follows, I will show that actually, this strategy is not defensible.

Once one has accepted that dispositions are relational properties – or historical properties supervenient on or grounded by relational properties – one still needs to assess what position they occupy within the hierarchical structure of the world. First, one could maintain that (some of) those dispositions are fundamental: the world is ultimately made up of momentary bare particulars with no intrinsic properties, which stand in dispositional relations. This move leads to the view defended by Dipert (1997), who claims that the world has an asymmetric graph structure, with bare particulars as vertices and relations as edges. He also shows that it is possible, by employing the mathematical theory of graphs, to establish with no circularity that the *relata* (i. e. the vertices) are numerically distinct²⁴.

²⁴Actually, the present view amounts to the conjunction of Dipert's theory together with the claims that the edges/relations are dispositional and that the bare particulars that occupy the vertices are momentary.

However, Oderberg (2011) has compellingly argued that Dipert's theory has very implausible implications: in particular, the destruction of even only one *relatum* might cause the destruction of the whole world, and all the moves suited to remove that problem would generate even more implausible consequences.

The only way to free the present view from the troubles with Dipert's theory is to posit a basis of categorical properties on which dispositional relations supervene, maintaining that those relations arise from that basis by some kind of metaphysical determination or grounding. Unfortunately, even in this case, things are more complicated than they look at first glance. One might think that, given two momentary objects, the dispositional relations obtaining between them are locally supervenient on their categorical properties and spatiotemporal relations, and, globally, the network of dispositional relations supervenes on a basis of categorical properties and spatiotemporal relations. But one must remember that whether a certain dispositional relation obtains or not between two objects also depends on whether those are temporal counterparts of each other, and that counterparthood seems to be irreducible to spatiotemporal continuity (Hawley 2001: 70). Therefore, defenders of the present solution should maintain that the supervenience basis also includes counterparthood relations. It seems that this view has not only to posit some kind of mysterious, unexplained brute necessitation, but it is also committed to taking counterparthood as an irreducible feature of the world playing a major and pervasive causal role; as we have already seen in section 3, this commitment is problematic too.

If one is not happy with this brutalism and primitivism, I see at least one alternative, which is to maintain that dispositional relations are determined by some more basic features of the world by mere supervenience, without invoking any kind of grounding or special metaphysical determination. In the next sections, I will explore a way to work out such a view by resorting to a version of the best system account of laws of nature – hence BSA – that has been defended by Loewer (2007) and Hall (2015). In particular, I will show how four-dimensionalists might employ this framework to claim that dispositional properties are supervenient only on the spatiotemporal arrangement of simples. Whether, at the end of the day, the resulting picture is tenable or not is a question that requires additional work in related areas of metaphysics and philosophy of science, which here I will be able only to sketch.

3. Manufactured Properties and Humean Laws

According to BSA, the laws of nature of a world w are (all and only) the regularities of the best system of w . The best system of w is the true theory of w that achieves the optimal balance of informativeness and simplicity. I will name *nomic dispositions* those dispositions that are involved in laws of nature, mass and charge being the most obvious examples. The relational view of dispositions that I want to explore here is that those nomic dispositions are extrinsic properties that supervene only on the spatiotemporal arrangement of momentary simples, whereas the fundamental, intrinsic properties of simples are purely categorical and are not involved in any way in the laws²⁵.

If a disposition is individuated by its nomic role, then it occupies the same role in all the possible worlds where it is exemplified: laws involve only dispositional relations that consist in fitting certain patterns of spatiotemporal distribution. To put it with a slogan, laws and nomic dispositions come together, in the sense that two worlds with the same laws have the same nomic dispositions, and the nomic environments of two worlds with the same nomic dispositions are at least similar, though not necessarily the same, since some dispositions are likely to tolerate some degree of variations in the laws that they are involved in. For instance, it seems that both a Newtonian world and a relativistic world contain masses, even if they have different laws; nonetheless, their nomic environments are similar, because the laws of the former are an approximation of the laws of the latter.

One can still maintain that underneath laws and dispositions there is a bottom level of momentary simples that exemplify fundamental, purely categorical intrinsic properties, which is sufficient to avoid the absurd implications of Dipert's relationism highlighted by Oderberg (2011) and discussed in section 2 of this chapter. However, there is no relevant connection between those fundamental properties and the nomic environment above them, since only the web of spatiotemporal relations makes a difference for the laws: take a world, swap the distribution of fundamental properties among simples without modifying their positions, and the laws are still the same.

Hall claims that the properties picked up by the best system are *manufactured magnitudes*: that in the world there are (objects which have) certain dispositions/magnitudes depends on the best system saying that there are (Hall unpublished mn, 2015). If taken literally, this formulation suggests a kind of instrumentalist fictionalism

²⁵Incidentally, the position of Lewis himself on this issue would be hard to assess: on one hand, he suggests that those fundamental properties are categorical. On the other hand, as examples of fundamental properties, he always mentions physical magnitudes such as mass and charge, which actually are dispositional properties.

about dispositions/magnitudes: that there are (objects which have) masses or charges is just a fiction employed by our best predictive apparatus, and actually there are no such features in the world. A theory that talks about them is false, even if it is an efficient predictive machinery. I suggest that Hall's ideas can be rephrased in a way that is both clearer and compatible with scientific realism by embracing the view that the properties/magnitudes involved in laws are extrinsic properties that consist in entering into certain patterns of spatiotemporal arrangement, and thus are supervenient on the spatiotemporal distribution of simples²⁶. This enables us to clarify the sense in which they are "manufactured": given that naturalness comes in degrees and granted that fundamental properties are perfectly natural, those magnitudes can be said to be manufactured in so far as that their degree of naturalness is very low or, to put it in a cruder way, they are not natural. The outcome is a view of science that, though not instrumentalist, entails epistemic limitations even deeper than the Ramseyan humility defended by Lewis himself (2009)²⁷: perfectly natural properties occupy no role at all in the best system; patterns of spatiotemporal arrangement and motion²⁸ are the only features of the world that science is able to capture, whereas natural properties fall outside the scientific domain.

Let us summarise this overall picture of persistence, supervenience, dispositions and laws: there is a basis of momentary simples that exemplify intrinsic, perfectly natural and purely categorical properties, which stand in a certain spatiotemporal arrangement; all of the other facts are supervenient on this basis. If one prefers Exdurance Theory, then the objects that laws are concerned with are momentary objects; in particular, the fundamental nomic objects are momentary simples. If one prefers Perdurance Theory, then laws are concerned with perduring objects, some of which are sums of momentary simples: those are the objects a fundamental physical theory is likely to talk about. In either case, nomic/dispositional properties (e.g. mass and charge) are relational properties exemplified by persisting objects, which consist in fitting a certain web of spatiotemporal distribution. Those properties are individuated by the role that they occupy in the best system, and thus they occupy the same role in all the possible worlds where they are exemplified. Furthermore, all of the worlds where they are exemplified must be at least nomicallly

²⁶A reading along these lines is also proposed by Miller (2014).

²⁷ Lewis (2009) argues that all we can know about fundamental properties is that there are some fundamental properties that play certain nomic roles, as shown by the Ramseyfication of the best system. On the other hand, we cannot know which property plays which role.

²⁸ Hall argues that one of the motivations for this view is that "... the primary aim of physics ... is to account for *motions*, or more generally for change of spatial configurations of things over time" (unpublished mn.: 29).

similar. Those dispositions/magnitudes can be said to be *manufactured* in so far as they are not natural. What the laws and the dispositions/magnitudes of a world w are, is supervenient on its spatiotemporal arrangement of momentary simples, and it depends on the role they occupy in the regularities of the best system of w – namely, the true theory of w which achieves the optimal balance of simplicity and informativeness.

This view not only avoids the absurd implications of Dipert’s relationism, but it also avoids every kind of mysterious brutalism and primitivism about the determination of dispositions by a more fundamental basis: dispositions supervene on the spatiotemporal arrangement of simples just because they are relational properties that consist in fitting certain patterns of spatiotemporal arrangement. They do not need any special metaphysical determination just like geometrical properties do not need any: squareness supervenes on the spatiotemporal arrangement of simples just because it consists in matching a certain pattern of spatiotemporal arrangement. In both cases, it seems that we are dealing with good candidates as brute facts, facts that do not require any further account or explanation.

That being said, there are still other issues that four-dimensionalists have to address to make this view tenable. In particular, what kind of simplicity can the best system strive for within the present framework? As one can easily guess, only syntactical simplicity can be sought. In the next section, I will show that this is a difficulty for the present account of laws and dispositions, and makes the whole package deal problematic.

4. Building a Naturalness-Free BSA

One of the simplicity requirements originally stated by Lewis for the best system is that its predicates and functors denote natural properties: the degree of simplicity of a system is not exhausted by its syntactical features (e.g. number and length of axioms, number of undefined non-logical constants etc....) but it also depends on the way it “carves nature at the joints”. Indeed, there are syntactically simple theories that provide a trivial description of the world: Lewis considers a first-order theory whose only non-logical axiom is “ $\forall xF(x)$ ”, where the predicate “ F ” is defined by enumeration as applying to all and only the actual objects (Lewis: 1986b). This toy-theory is true and is as syntactically simple as a theory can be. Moreover, it is highly informative relative to its language, since it allows us to assess, for every object x , that x is F , ruling out the alternative that x is not F . Nevertheless, simplicity being merely syntactical makes informativeness epistemically empty. Therefore, a naturalness requirement seems the only way to give both simplicity

and informativeness an objective, extra-linguistic ground: in particular, Lewis's version of BSA rejects this toy-theory because "F" does not denote a natural property, so its simplicity and informativeness are not objective.

According to the view that we are exploring, the best system of the world involves no reference to natural properties, but only to non-natural, "manufactured" properties/magnitudes. A version of BSA dispensing with Lewis's naturalness requirement becomes closer and closer to scientific instrumentalism: the objects that a scientific system is concerned with are just gerrymandered series of momentary stages matching certain patterns of spatiotemporal arrangement. The best system is still the one that optimizes informativeness and simplicity, but those requirements are to be conceived, in a more modest fashion, as merely syntactical: Sider's slogan that "it's better to think in joint-carving terms" (2011: 77) is plainly rejected. This view has been explicitly embraced by Loewer, who has claimed that the best system merely needs to optimize syntactical simplicity and informativeness in respect to the language it is formulated in: there is no need at all for predicates and functors that denote natural properties/magnitudes (Loewer 2007). One can still combine this account with a minimal version of scientific realism, construed as the view that a corroborated scientific theory is true or approximately true. Nevertheless, there are many alternative systems each of which is the best in respect to its own language, and none of them can claim any privileged correspondence to the world: in Putnam's colourful words, this view rejects the hard-core realism which posits a 'ready-made world' (1982).

The kind of under-determination entailed by this view goes much further than the empirical under-determination of, say, Lagrangian mechanics in respect to Hamiltonian mechanics, or that of wave mechanics in respect to matrix mechanics: besides proper scientific theories, we have a plethora of (true) theories employing gerrymandered concepts, such as the theory ' $\forall xF(x)$ ' considered by Lewis, which nonetheless exhibit a high degree of syntactical simplicity and informativeness within their own languages. How can we account for the difference between such trivial theories and proper scientific theories without resorting to any naturalness requirement? Furthermore, a naturalness-free version of BSA also seems to lead to a kind of anti-realism about laws: a regularity is a law or not only within a certain system, so there are no laws of nature *simpliciter*. Anti-realism about laws entails anti-realism about dispositions/magnitudes as well: since those are just the properties that occupy a role in laws, systems that pick up different laws also deliver different packages of dispositions/magnitudes. Again, whether the world contains or not

(objects with) masses or charges is always relative to a certain system, unless one proposes a way to select a privileged package of laws and dispositions/magnitudes.

The solution suggested by Loewer (2007) is that, among the systems that are the best in respect to their own language, there is one that is formulated in a special language – namely, the language actually employed in science, as it has been historically determined within the scientific tradition. The reason why certain systems are non-starters is simply that their language is too far from that of science. The privileged package of laws and properties is the one yielded by this “truly” best system. For obvious reasons, Loewer has named his theory *Package Deal Account*, hence *PDA*. Loewer argues that this account has the advantage that it is more closely related to actual scientific practice than BSA: trivial theories such as “ $\forall xF(x)$ ” are not worth considering just because they lack any proper scientific credential. PDA directly incorporates this fact into an account of laws of nature, instead of invoking metaphysical concepts that play no role in science.

The main problem with Loewer’s strategy is that it merely states the superiority of actual science over the alternative systems without accounting for that, and then it singles out laws of nature as the main outcome of the scientific enterprise. On the contrary, we expect that a theory of laws first explains why laws are somehow more fundamental and/or explanatory than non-nomic regularities, and then why their discovery should be one of the main goals of science. Another problem is that PDA depicts scientific inquiry as an arbitrary activity: if, as Loewer maintains, the goal of science is to discover truths while optimizing the balance of syntactical simplicity and informativeness, why should scientists care about achieving that goal only within a certain linguistic/conceptual tradition? Suggestive as it can be as a proposal, Loewer’s PDA needs to be refined: until such refinements are worked out, it is an open question whether PDA can help four-dimensionalists to find a place for dispositions within their ontology. At the current stage of the debate, it seems that Endurance Theory is way better off than Four-Dimensionalism when it comes to finding a place for dispositions.

Summary

We have seen that defenders of Four-Dimensionalism have to deal with the construction of an adequate account of dispositions and that it is not obvious whether such an account is available to them. Given these troubles with dispositions, one might be tempted to deny

that ordinary objects have dispositional properties at all, but this option is unpalatable, because those properties are an indispensable ingredient of scientific explanation: natural science gives us strong reasons to posit a rich inventory of dispositions, and a metaphysical theory that does not find a place for them is not worth taking seriously. One could speculate that a more mature physics will empty our ontological landscape of dispositions²⁹, but, as Blackburn observes, “any conceivable improvement in science will give us only a better pattern of dispositions and powers” (1990: 63), because physicists study physical objects by observing the way in which they interact and the only properties that one can detect through this method are dispositional. To hope for a dispositions-free science would be mere wishful thinking.

With this in mind, the most promising approach available to four-dimensionalists seems to me to take dispositions as relations or extrinsic properties and to adopt the Loewer-Hall version of the best system account of laws of nature, accommodating those properties within a comprehensive picture of persistence, supervenience, and laws. That being said, we need additional work to assess whether, all things considered, the whole package deal is tenable. The only alternative would be to take extrinsic/relational dispositions as brutally determined by a fundamental distribution of categorical properties, spatiotemporal relations and irreducible counterparthood relations. Until Loewer’s PDA has been refined, it seems that Four-Dimensionalism can accommodate dispositions only at costs that Endurance Theory is free from, which counts as an advantage of Endurance Theory over Four-Dimensionalism in both of its varieties – namely, Perdurantism Theory and Exdurantism Theory. Besides the debate between Endurance Theory and Four-Dimensionalism, a more general lesson that one can draw from the present inquiry is that metaphysical problems are variously interconnected, and before endorsing strong positions about a certain metaphysical issue one should investigate the relationships between that and other, apparently unrelated issues.

²⁹This kind of faith in a forthcoming elimination of dispositions from science is embraced, for example, by Quine (1969).

Chapter 4. Existential Fragility and Stage Replacement Within Four-Dimensionalism

Introduction

Endurance Theory is standardly stated as the view that ordinary objects – objects such as human beings, cats or chairs – persist over time by being wholly present at different times.³⁰ By contrast, Four-Dimensionalism maintains that no object is wholly present at more than one instant: the world is ultimately made up of momentary objects, each of which exists for exactly one instant. Those momentary objects are arranged into natural series, series whose members are related by some appropriate continuity.³¹ Different versions of Four-Dimensionalism offer different accounts of the place occupied by ordinary objects within this ontology: according to Perdurantism Theory, an ordinary object is a sum of momentary objects arranged into a natural series. According to Exdurantism Theory, an ordinary object just is identical to a momentary object, and it is vicariously present at other times in so far as other momentary objects of the same series are directly present at those times. In chapter 1, I have proposed to regiment Four-Dimensionalism as the view that ordinary objects have incompatible properties only as relational properties that involve other objects: this regimentation coheres with the present picture, because those other objects are what are standardly called the *temporal stages* of objects.

Endurance Theory and Four-Dimensionalism (in both its versions – namely, Exdurantism Theory and Perdurantism Theory) seem to be committed to different views of the existential stability of objects. Four-Dimensionalism is committed to the view that momentary objects pass away instantaneously and then are eventually replaced by later objects that have some appropriate continuity with the earlier ones; in what follows, I will use the phrases “existential fragility” and “stage replacement” as shorthands for those commitments. By

³⁰ This way of formulating Endurance Theory is admittedly rough. The most popular way of regimenting Endurance Theory is offered by so-called *Locationalism* (Parsons 2007): see chapter 1 of the present work for a proposal of a different way of formulating Endurance Theory. In section 8, I will discuss whether the locationalist way of framing the debate makes any difference for my arguments.

³¹ What this continuity consists in is controversial. Hawley (2001) has convincingly argued that spatiotemporal continuity, qualitative similarity and causal/counterfactual dependence are not suited for this role, so four-dimensionalists might need to invoke an irreducible relation of temporal counterparthood.

contrast, Endurance Theory seems to attribute to ordinary objects what might be called “existential inertia”³²: ordinary objects tend to remain in existence unless some perturbing event makes them pass away. What kind of perturbation is required to make an object pass away varies according to the natural kind that it belongs to: what can make a dog pass away is vastly different from what can make an electron pass away.

This basic difference has been largely overlooked in the debate between Endurance Theory and Four-Dimensionalism. Both endurance theorists and four-Dimensionalists agree that which of the two theories is the most plausible one is to be assessed on other grounds, for instance by evaluating their suitability to account for qualitative change or to solve the puzzles of material constitution and material coincidence.³³ As far as I am aware, nobody has ever argued that a commitment to existential inertia is more plausible than a commitment to existential fragility and stage replacement, or *vice versa*. Actually, a worry about stage replacement is raised by Thomson (1983), who observes that, according to Four-Dimensionalism, momentary objects come into existence *ex nihilo*, because they are not composed of previously existing objects. However, Thomson does not explain why this should be problematic.

In what follows, I will show that this difference is relevant to the adjudication of the dispute between Endurance Theory and Four-Dimensionalism. Indeed, it turns out that endurance theorists do not need any special metaphysical principle or postulate to account for existential inertia, whereas four-dimensionalists can accommodate existential fragility and stage replacement only at a certain cost. I will argue that this asymmetry counts in favour of Endurance Theory over Four-Dimensionalism. As will be clear, the difficulties faced here by four-dimensionalists are related to those that I have discussed in chapter 3.

1. Destructive Dispositions

According to Endurance Theory, ordinary objects are enduring objects. With this in mind, what makes an object remain in existence or pass away? Rundle claims that “in the absence of forces which would bring them to an end, their continuation from moment to

³²The locution “existential inertia” has been traditionally used in the theological debate on the role of God in the conservation of the world. Here I will employ it in a more general way, without any theological connotation.

³³ For instance, Sider (2001) and Hawley (2001) claim that the main argument in favour of Four-Dimensionalism over Endurance Theory is that the former provides a better solution to the puzzles of material constitution and material coincidence.

moment is in no need of explanation” (Rundle 2004: 93). But one might wonder why such a continuation is in no need of explanation. Logical and analytic truths are the most obvious examples of truths that do not need to be explained, but Rundle’s claim about objects is neither a logical nor an analytic truth. As Oderberg observes (2014a: 351), the claim that objects remain in existence unless they pass away would be analytic, but this is not what Rundle is saying: he is rather making a substantive claim about the relation between an object remaining in existence and the presence or absence of “contrary forces”.

With this in mind, Rundle’s remark is best stated as the view that objects behaving that way is a fundamental metaphysical law, which does not require any explanation in terms of more fundamental facts: it is just a metaphysical law that objects remain in existence by default unless some “contrary force” prevents them from that. If Rundle is right, then endurance theorists need a substantial metaphysical commitment to account for existential inertia. That being said, I will show that actually endurance theorists do not need to invoke any such law, since endurance and passing away can be accounted for by appealing only to the causal structure of the world as it is revealed by natural science.

In what follows, I will talk about dispositions in a theoretically neutral way, to refer to properties such as fragility, water-solubility, and acidity. In general, dispositions are those properties that consist in displaying a certain kind of manifestation under a certain kind of condition or stimulus. With this in mind, I will not be committed to the broadly Neo-Aristotelian view that dispositions are irreducible powers (Molnar 2003; Mumford 2003; Bird 2007). Under the broad use of the term “disposition” that I am adopting, even Humeans can – and indeed often do – maintain that objects have dispositions, even when they try to analyse them by means of some counterfactual paraphrase (Lewis 1997a).

Let us start with an intuitive principle about the relationship between change and dispositions: if an object a undergoes a change m in the circumstance c , then it has the disposition to undergo a change of kind M in circumstances of kind C , with m being a change of the kind M and c being a circumstance of the kind C .³⁴ In other words, the change that has been undergone by the object reveals the presence of a related disposition – namely, a disposition of which that change is a manifestation. This principle applies to passing away as well: an object passing away requires that object having what I will call a *destructive disposition*, which is a disposition whose manifestation involves the passing

³⁴ It is worth noticing that cases such as that of the finkish dispositions (Martin 1993) are not a counterexample to this principle, but rather to its converse, which is the following: if an object a is disposed to undergo a change of kind M in circumstances of the kind C , then, if circumstances of the kind C occur, then a undergoes a change of kind M .

away of the object itself.

I am not claiming that destructive dispositions have to be fundamental and irreducible: arguably, many of them are grounded by a more fundamental disposition whose manifestation involves the loss of the essential nature of the object and hence the destruction of the object itself. For instance, the disposition of a salt crystal to pass away in water is grounded by its water-solubility, whose manifestation alters the structure of the crystal. By contrast, objects that are not subject to any structural or qualitative change, such as elementary particles, can pass away only by manifesting a fundamental destructive disposition: for example, elementary particles seem to have a fundamental disposition to be annihilated when colliding with a related anti-particle.³⁵ It is also worth noticing that the passing away of the object has not by any means to be the only effect involved in the manifestation of a destructive disposition: for example, the annihilation of an elementary particle co-occurs with the coming into being of new particles.

Finally, a destructive disposition can also be a stochastic propensity, whose manifestation is not guaranteed to occur at any particular time: appropriate conditions being present, the object has a certain objective probability (other than 0 and 1) to pass away within a certain period of time. Within the model of propensities outlined by Ellis (2001: 132), a destructive propensity to pass away in the conditions of the kind *C* is defined by a related statistical law: for any object *x*, if *x* has such a propensity at *t*, then for any time duration δ , there is an objective probability $p(x, \delta)$ that if *x* underwent the conditions of the kind *C* at *t*, then *x* would pass away by $t + \delta$. An example is offered by the non-fundamental disposition of certain radioactive atoms to pass away within a certain period of time because of the emission of alpha particles: in this case, the propensity to pass away is grounded by a more fundamental propensity to emit alpha particles.

2. Existential Inertia

In this section, I will discuss the implications of the view above for the issue of existential inertia. Within endurance theory, there is nothing metaphysically peculiar about the kind of events required to make an ordinary object pass away: an ordinary object passing away just depends on the manifestation of a certain disposition, which only requires the presence of

³⁵Here I am assuming, for the sake of exemplification, that elementary particles are mereologically simple.

an appropriate stimulus. In this respect, an object passing away is not more mysterious than an object undergoing any other kind of change, be it qualitative, relational or whatever one wants. Likewise, an object remaining in existence is not more mysterious than an object remaining in any other state.

At this stage, a bit of terminology will be helpful: for any disposition D , which consists in displaying a manifestation of the kind M in the circumstances of the kind C , let us say that D is trivial if and only if $C=U$, where U is the set of all possible circumstances. To put it in an informal way, a trivial disposition is a disposition that is manifested in all possible circumstances. A disposition is non-trivial if and only if it is not trivial.³⁶ With these definitions in mind, the following principle seems warranted:

Complementarity Principle: For any object x and any non-trivial disposition D to display a manifestation of the kind M in (and only in) the conditions of the kind C , if x has D then x also has the disposition D' not to display a manifestation of the kind M in (and only in) the conditions other than those of the kind C .

The Complementarity Principle says that, if an object has a certain disposition D , then it also has a disposition complementary to D . I maintain that this principle is not only intuitively plausible, but it is also free from any ontological commitment. At first glance, it might seem committed to an ontology of universals or tropes, because it seems to quantify over dispositions: if there are entities such as dispositions, they are properties, which are either universal or particular. That being said, here every commitment to universals or tropes is avoidable, since the Complementarity Principle can be rephrased only by talking about objects being disposed in certain ways:

Complementarity Principle:* For any object x , if x is non-trivially disposed to display a manifestation of the kind M in (and only in) the conditions of the kind C , then x is also disposed not to display a manifestation of the kind M in (and only in) the conditions other than those of the kind C .

Given these qualifications, I will keep on talking, for brevity, about dispositions, but the

³⁶ One might argue that no disposition is manifested in all possible circumstances; therefore, there are no trivial dispositions. Here I am not committed to the possibility of trivial dispositions: indeed, I do not exclude that there might be no such dispositions. If there are no trivial dispositions, then the non-triviality condition is satisfied by every disposition.

reader should keep in mind that quantifying over dispositions is dispensable for the arguments that I am outlining.

From the Complementarity Principle, it follows that every object that has a destructive disposition also has a certain disposition to remain in existence, which is the disposition complementary to its destructive disposition. If an object has the disposition to pass away in (and only in) the conditions of the kind C , then it also has the disposition to remain in existence in (and only in) conditions other than those of the kind C .³⁷ Something analogous applies to objects with a stochastic propensity to pass away: if an object has a propensity that entails an objective probability p (with $0 < p < 1$) to pass away by a time t in the conditions of the kind C , then it has a complementary propensity that entails an objective probability $1-p$ to remain in existence by t (in the conditions of the kind C). Be it a causal disposition or a stochastic propensity, the disposition to remain in existence of an object can be aptly called the *existential inertia* of that object.

In conclusion, within an endurantist framework, there is nothing spooky in attributing an existential inertia to ordinary objects. To talk about the existential inertia of an object that is enduring is not different from talking about the “malleability inertia” of a piece of iron that is not undergoing a compressive stress: in both the cases we have just an object that is not manifesting a certain disposition, and which on the other hand is manifesting the complementary disposition to remain in a certain state. With this in mind, the perturbation that makes an object pass away is simply a stimulus of the kind that makes it display its destructive disposition. As I have already stressed, talking about such dispositions does not bring any substantial metaphysical commitment, because positing a certain disposition entails *ipso facto* positing its complementary disposition as well.

3. Staying Liberal About the Modal Space

In this section, I will argue that endurance theorists can be very liberal about the space of metaphysical possibilities: they do not have to impose any arbitrary constraint on it and, among the other things, they can also admit the possibility of worlds with no enduring objects.

First, Endurance Theory does not rule out the metaphysical possibility of an object that

³⁷The view that objects have the tendency to remain in existence has been also defended by Oderberg (2014a: 349-53).

has no destructive disposition: that would be an incorruptible object, an object that not only never passes away, but that cannot pass away, and has the disposition to remain in existence in every possible condition. Endurance theorists can also grant the possibility of an object that has no existential inertia at all, having the disposition to pass away whatever features its environment has: such an object would be necessarily momentary. That would be an odd entity with regard to the kinds of objects and causal processes that we actually observe, but I see no reason to reject its metaphysical possibility. The reason why this is not going to be a problem for endurantists is that the common version of Endurance Theory does not amount to the view that *all* objects endure, but to the weaker view that those objects that persist do so by enduring, together with the claim that ordinary objects belong to that cohort. Therefore, endurance theorists can grant that momentary objects are at least metaphysically possible.

Incorruptible objects and momentary objects with no existential inertia can be viewed as occupying the two extremities of a continuum of possibilities: which of those possibilities are realized is a contingent matter, depending on the causal structure of the world. Ordinary objects, which are corruptible but have some degree of existential inertia, are located somewhere between those extremities, and have a higher or lower tendency to remain in existence according to the range of environmental conditions compatible with their endurance and to the frequency and likelihood of those conditions, which ultimately depends on the overall furniture and laws of the universe. Atoms of unstable isotopes offer an obvious example of objects with a low but non-null existential inertia, whereas stable isotopes and multicellular living organisms are instances of corruptible objects with a high existential inertia.

Endurance Theory not only allows for the possibility of momentary objects but also for a possible world entirely made up of momentary objects. Likewise, it leaves room for possible worlds where momentary objects are arranged into continuous series. Would that be a world of objects that perdure/exdure, according to Endurance Theory? The answer to this question makes no difference here. The first answer available to endurance theorists is to insist that (i) in such a world no object persists because no object endures. Alternatively, they can grant that (ii) whether Endurance Theory is true or Four-Dimensionalism is true is a contingent matter³⁸ and that in such a world, objects perdure or exdure. The second option might be defended by endorsing the Lewisian view that the referents of a theoretical

³⁸That how objects persist may be a contingent matter has actually been acknowledged by defenders of Four-Dimensionalism, such as Hawley (2001: 207-8).

term are those entities that best realize the related role³⁹: given this view, one could maintain that in such a world the natural series of stages are the best candidates as persisting objects. In either case, endurance theorists can be very liberal about the space of metaphysical possibilities, acknowledging even the possibility of a world of momentary objects – and maybe mereological sums of momentary objects – with no tears.

Let us take stock: we have seen that, to account for existential inertia, endurance theorists do not need to assume any basic metaphysical law or to posit any special property. Likewise, they can afford to be very liberal about the space of metaphysical possibilities. In what follows, I will show that four-dimensionalists are much worse off in those respects.

4. Existential Fragility

As I have stressed in section 3, endurance theorists are not committed to the claim that all objects endure. By contrast, four-dimensionalists embrace the universal claim that no object endures. Nonetheless, they do not claim that human stages and banana-stages are arbitrarily spread over spacetime: human stages are arranged into series of human stages, and banana-stages are arranged into series of banana-stages. In general, momentary objects are arranged into natural series. Why is the world that way? To posit a mosaic of brute facts consisting of momentary objects existing for exactly one instant and arranged into natural series would amount to positing a cosmic coincidence, which is hugely implausible. With this in mind, four-dimensionalists need to offer some explanation.

The first option available to four-dimensionalists is to explain existential fragility and stage replacement in terms of some underlying causal mechanism. For example, one could maintain that every stage of every natural kind has no existential inertia. Instead, every stage has the destructive disposition to pass away instantaneously whatever features its environment has: that disposition might be aptly called *existential fragility*. Furthermore, each momentary object is replaced, given certain conditions⁴⁰, by another object that has an appropriate continuity with it: four-dimensionalists might account for this replacement by assuming that every momentary object also has the disposition to make an object

³⁹ See Lewis (1994: 489) for a defence of the view that something can count as the referent of a theoretical term though it realizes the related role only in an imperfect way. An insightful discussion of the Lewisian approach is offered by Schwarz (2015).

⁴⁰ This clause is required to accommodate the fact that an ordinary object stops persisting when the related series of stages is interrupted: thus, it is not the case that a stage is replaced by a later one in every possible condition.

appropriately related to it come into being (in certain conditions). To summarise, four-dimensionalists might maintain that momentary objects have these highly complex destructive-and-creative dispositions, whose manifestations consist in passing away instantaneously while creating a later object that has an appropriate continuity with the earlier one.

Even if one is willing to grant that those dispositions are metaphysically possible, here Four-Dimensionalism is concerned not with mere possibility, but with the features of the actual world. Therefore, it would need to maintain that the actual objects have those dispositions: as a hypothesis in the philosophy of nature, this is just strained, since it indulges in an armchair physics, introducing unheard of, gerrymandered natural properties only to accommodate a strong metaphysical claim.

Alternatively, four-dimensionalists might invoke spacetime. First, they might endorse spacetime substantivalism – namely, the view that there are things such as spatiotemporal regions, as well as the whole spatiotemporal manifold. Then, they might maintain that the spatiotemporal manifold has the disposition to make every object pass away instantaneously, and to arrange momentary objects into natural series. Again, this would amount to doing yet more armchair physics, attributing to spacetime *ad hoc* properties that do not figure in relativistic physics. We have seen that endurance theory does not need any postulation of that kind: at the end of the day, endurance theorists only need the dispositions normally required to account for causal explanations, so they can confine those odd dispositions to the realm of mere possibility.

5. *De Re* Modal Constraints

If four-dimensionalists want to account for existential fragility and stage replacement in terms of the causal structure of the world, then they seem to be in bad shape, or, at least, in a position much worse than that of endurantists. Given these troubles, a defender of Four-Dimensionalism might argue that the fact that actual objects do not endure does not require any causal explanation, but only a purely metaphysical explanation, and such an explanation is that they *cannot* endure. But why? One might be tempted to argue that the actual momentary objects are necessarily momentary and arranged into natural series by attributing to them the *ad hoc* dispositions that we have met in section 4 and endorsing some kind of dispositional essentialism, but that view would have the difficulties that we

have already seen.

A strategy that seems more promising is to identify physical objects with regions of spacetime: an object is not only located at a spatiotemporal region, but it just *is* that region. Though not following from four-dimensionalism alone, this claim has been variously defended by some four-dimensionalists⁴¹, and here it seems to deliver an elegant account of existential fragility: every momentary object passes away instantaneously because it is identical to a temporally unextended spacetime region, so it essentially occupies a certain temporal slice of the spacetime.

The well-known problem with identifying physical objects with spatiotemporal regions lies in the modal differences between them: an object might have occupied a different position, whereas a spatiotemporal region seems to occupy a certain position essentially. The best strategy for avoiding this trouble is to invoke modal counterpart theory: according to this framework, whether an object has a certain property essentially or accidentally depends on the properties of its modal counterparts. The counterpart of an object *a* in the world *w* is the denizen of *w* that resembles *a* the most. i.e. more than any other denizen of *w*. Comparative resemblance varies according to the respect that one takes into account, so the modal counterparts of an object can be variously picked up considering the object itself under different respects.⁴²

Given this apparatus, even if an object is identical to a spatiotemporal region, it has its location essentially only *qua* container, and accidentally *qua* filler (Schaffer 2009: 145). Whether or not this solution is satisfactory, it would undermine the present attempt to account for existential fragility: if an object has a position essentially only *qua* container, then the loss of the position makes it pass away only *qua* container. Therefore, that modal property only explains the existential fragility of that object *qua* container. But according to Four-Dimensionalism, a momentary object passes away instantaneously *simpliciter*, not just under a certain qualification.

In conclusion, even identifying objects with spatiotemporal regions does not help here, because the only defensible version of this view is ill-suited to account for existential fragility. Furthermore, it does not explain why stages are arranged into natural series.

⁴¹This view was originally put forward by Quine (1976) and has been recently defended by Sider (2001) and Schaffer (2009).

⁴² Counterpart theory was prominently outlined and defended by Lewis (1968, 1986a).

6. *De Dicto* Modal Constraints

Given the difficulties with the strategies above, four-dimensionalists might try to go even further, claiming that the impossibility of actual objects enduring does not need to be explained by their essential properties, since endurance is impossible *de dicto*: not only there is no world where the actual objects endure, but it is impossible that there are enduring objects at all. Likewise, it is impossible that stages are spread over spacetime in an arbitrary way: it is just a metaphysical necessity that objects pass away instantaneously and are replaced, given certain conditions, by objects that have an appropriate continuity with the earlier ones.

This move would not be innocent: for instance, Hawley concedes that there is no argument showing that endurance is incoherent; therefore, even if Four-Dimensionalism is true, it is true only contingently (2001: 207-8)⁴³. It seems that the only way to avoid these conclusions is to take the impossibility of endurance as brute. Likewise, worlds made up of momentary objects that are arbitrarily spread over spacetime – rather than arranged into natural series – seem possible too: to account for the arrangement of momentary objects into natural series, four-dimensionalists should take as brute even the impossibility of those worlds.

Alternatively, one might try to account for those modal constraints by positing a fundamental metaphysical law establishing that every object that comes into being passes away instantaneously and is replaced, given certain conditions, by another object having an appropriate continuity with it. Such a law would be something analogous to the laws of nature posited by Maudlin (2007: Ch. 1): a fundamental, *sui generis* entity that “governs” becoming. But is this a better point to stop than positing a brute necessity? Actually, this move seems even less palatable, since – besides positing a *sui generis* entity – it needs to invoke some kind of brute metaphysical determination or grounding relation to explain how objects are “governed” by that entity.

Whatever option one prefers, the worry with the present strategy is that it involves an arbitrary restriction of the space of metaphysical possibilities, at least compared to

⁴³Hawley claims that the main argument in favour of Four-Dimensionalism over Endurance Theory is that the former provides a better solution to the puzzles of coincidence and material constitution. But, she adds, that argument would not be available in a possible world with “few, sharply bounded objects” (2001: 208).

Endurance Theory, according to whom the tendency of objects to remain in existence or not depends just on the causal structure of the world, and there are possible worlds that contain objects with vastly different tendencies, even worlds entirely made up of momentary objects. To adopt the vivid theological metaphor employed by Goff in another context, such a version of Four-Dimensionalism would be committed to “a strange and arbitrary limiting of the creative powers of God” (2010: 46)⁴⁴, whereas Endurance Theory is not.

7. Eluding Existential Worries

Somebody might object that my whole point about existential inertia and existential fragility is misplaced, because I have not framed the discussion using an adequate formulation of Endurance Theory and Four-Dimensionalism. In section 1, I have provisionally stated Endurance Theory as the view that ordinary objects are wholly present at different times. As I have already highlighted in chapter 1, this formulation of Endurance Theory is defective: if taken literally, it entails that an ordinary object is present with all its parts along the entire period of its existence. However, this view is not what endurance theorists are committed to: indeed, they want to grant that compound objects change their proper parts over time. The dissatisfaction with this formulation has led metaphysicians to search for alternative ways of framing the debate between Endurance Theory and Four-Dimensionalism, the most popular candidate being probably so-called *Locationalism*.

As the name suggests, Locationalism (Parsons 2007) is the view that both Endurance Theory and Four-Dimensionalism are best formulated by employing the concept of spatiotemporal location. Locationalism is committed to spacetime substantivalism: there are things such as spatiotemporal regions, and objects occupy spacetime regions by entertaining with them an irreducible relation of spatiotemporal location. With this in mind, the friends of Locationalism claim that the difference between Endurance Theory and Four-Dimensionalism lies in the different answers that they give to the question “How are ordinary objects located in the spacetime?”. Indeed, Endurance Theory states that an ordinary object is multiply located across the temporal axis, because it exactly occupies distinct spatiotemporal regions. By contrast, Four-Dimensionalism denies that, stating

⁴⁴ Goff is concerned with the restrictions on the space of metaphysical possibility entailed by standard truth-maker theory.

instead that each ordinary object exactly occupies only one region. In particular, Stage Theory states that an ordinary object occupies an instantaneous region, whereas Perdurant Theory states that an ordinary object occupies a temporally extended region.

In chapter 1, I argued that Locationalism is inadequate to framing the debate between Endurance Theory and Four-Dimensionalism, and that generally those views should not be formulated in terms of presence-at-a-time or (spatio-)temporal location. Nevertheless, Locationalism might still offer the answer when it comes to accounting for the relationship between persisting objects and times/spatiotemporal regions. If one is inclined to adopt this framework, one might contend that talking in terms of existential inertia and existential fragility is inaccurate, because the relation between an object and a time is not to be analysed in terms of existence but rather in terms of (spatio-)temporal location. I am willing to grant this point, but I reply that it does not make any substantial difference for the present discussion: even if one refuses to talk about existential inertia and existential fragility, one can still talk about analogous tendencies, which might be called *locational inertia* and *locational precariousness*. The former would be the tendency to be located at subsequent times or spatiotemporal regions as well, whereas the latter would be the tendency not to be located at any later time or spatiotemporal region. Likewise, four-dimensionalists would still have to address stage replacement.

To sum up, it is irrelevant whether one prefers to analyse an object being present at a time in terms of existence or in terms of (spatio-)temporal location: in either case, endurance theorists have to account for existential inertia (or an analogous tendency), whereas four-dimensionalists have to account for existential fragility (or an analogous tendency), as well as for stage replacement. As I have shown in the previous sections, endurance theorists are better off than four-dimensionalists in this respect.

Summary

In conclusion, to account for the brief existence and the replacement of momentary objects, four-dimensionalists have either to posit *ad hoc* natural properties or to impose arbitrary constraints on the space of metaphysical possibilities. In either case, their commitment is stronger and more problematic than that of endurance theorists, according to which an object remaining in existence or passing away is due to the same sort of properties and processes of any other kind of change: the tendency of objects of different natural kinds to

endure or otherwise in certain conditions just depends on the causal structure of the world as it is studied by natural science. Likewise, endurance theorists can be liberal about the space of metaphysical possibilities in a way that four-dimensionalists cannot afford. As I have shown, this asymmetry between Endurance Theory and Four-Dimensionalism obtains no matter which regimentation of the two views one prefers.

It is easy to see that this problem with Four-Dimensionalism is entangled with the more general problems that Four-Dimensionalism faces when it comes to dispositions, which I have discussed in chapter 3. As I have shown, Endurance theorists have no problems with accounting for existential inertia. By contrast, if four-dimensionalists try to offer an analogous account of existential fragility, they face the general problems with accommodating dispositions within their ontology.

Let us take stock. In chapter 1, I have defended a new way to frame the debate between Endurance Theory and Four-Dimensionalism. In chapter 2, I have challenged a popular argument in favour of Four-Dimensionalism. In chapters 3 and 4, I have argued in favour of Endurance Theory over Four-Dimensionalism. Until now, I have not addressed the mereological nature of enduring objects – namely, whether at least some of them have proper parts, and, if they do, what is the priority/dependence order of them and their proper parts. This is going to be the main task of the next chapters.

Chapter 5. Eliminating Compound Substances

Introduction

In chapters 2, 3 and 4, I have argued in favour of Endurance Theory over Four-Dimensionalism. That being said, I have only defended the claim that objects endure rather than perduring or exduring, without investigating the mereological nature of those enduring objects. In the remaining part of this thesis, I will be defending a version of Endurance Theory according to which all enduring objects are either mereological simples – which are certain microscopic objects – or mere sums of mereological simples.

With this in mind, the present chapter is aimed at defending a version of ontological eliminativism, by arguing against the existence of compound substances – namely, compound, enduring objects that are, in some sense, something over and above their proper parts. After a preliminary discussion, I single out the two best candidates as views of compound substances. Then, I argue that their defenders have to account for certain relations obtaining between compound substances and their material constituents. I examine the strategies available to meet that requirement and I show that each of them is problematic. These difficulties provide, I will argue, a *reductio ad absurdum* of the existence of compound substances.

In chapters 2, 3, and 4, I have defended Endurance Theory over Four-Dimensionalism as an account of change and persistence. In this chapter, I will simply assume the truth of Endurance Theory. Those who are not convinced by my previous defence can at least take Endurance Theory as a working hypothesis: indeed, the popularity of Endurance Theory is wide enough to make its implication worth exploring anyway.

Some terminological clarifications are required. First, I will use “entity” as the most comprehensive terms, whose extensions include everything; within a formal language, talk of entities may be represented by means of standard singular quantification. By “object” I will mean a concrete entity, i.e. an entity having a spatiotemporal location. If one is inclined to think, for example, that a universal has a (multiple) location by being located where the entities exemplifying it are located, one can take a modified version of my definition, saying that a concrete entity is an entity having a spatiotemporal location in a primary, non-derivative way. If one is inclined to classify tropes (i.e. particular properties)

as concrete entities, one can modify again my definition by saying that an object is an independent concrete entity (while tropes are ontologically dependent on the objects in which they inhere).

I will stay agnostic about in which circumstances mereological composition occurs: in particular, I will stay agnostic about whether mereological composition occurs without any restriction. Nevertheless, I will need to talk about many objects taken together: to do that while remaining agnostic about composition, I will use informal phrases such as “aggregate”. According to one’s theoretical preferences, one can take me as talking about mereological sums or as using plural quantification. No particular mereological system is endorsed here; however, the binary predicate “_ is part of --” is assumed to apply where the referent of the left-hand term is a material constituent of the referent of the right-hand term; some difficulties with this view will be briefly discussed, but they will be ruled out as merely verbal disputes.

I take as an uncontroversial empirical truth that some objects are integrated wholes, i.e. physical systems whose members are unified by a steady organization, the most obvious example being offered by living beings and their homeostasis. By stipulation, I will assume that a simple object (i.e. a mereological atom) is an integrated whole vacuously. The concept of an integrated whole is vague, but it is still clear enough for some preliminary distinctions: the aggregate including Napoleon, a heap of sand and the moon is not an integrated whole, whereas an animal or a chemical atom are integrated wholes. I will use “substance” as a shorthand to denote enduring integrated wholes⁴⁵. Given this use of the term, most four-dimensionalists will grant that a human being is an integrated whole, but not that it is a substance: according to the terminology that I am adopting, a metaphysical theory is said to postulate substances if and only if it states that (some sufficiently) integrated wholes endure. By “compound substance” I refer to a substance that has proper parts.

Within an endurance-theoretic framework, relatively uncontroversial examples of compound substances would be living beings and molecules; more controversial – because of their lower degree of causal integration – cases might be artefacts, clouds and galaxies. A certain tradition coming from Aristotle himself claims that the objects that are substance *stricto sensu* have no other substances among their proper parts: that being said, here I am

⁴⁵Even if, of course, Aristotle was not concerned with the dispute between Endurance Theory and Four-Dimensionalism, this use of “substance”, together with the formulation of Endurance Theory that I have defended in chapter 1, resonates with the Aristotelian conception of a substance as an entity capable of receiving contraries.

going to use “substance” with a broader meaning, including enduring integrated wholes that are proper parts of other enduring integrated wholes too; under this broader use, for example, a cell of the body of Socrates is also a legitimate candidate as a compound substance. Finally, it is worth noting that not every enduring object is a substance, because it seems that, if a_1, a_2, \dots and a_n are enduring objects, then their aggregate endures as long as all of them exist; for instance, the aggregate of Alexander the Great and Bucephalus endures as long as both of them exist.

1. Two Accounts of Compound Substances

The starting point of every theory of substances is that an enduring integrated whole cannot be identified with the aggregate of its material constituents, because those constituents change over time: the most illustrative example is offered, again, by living beings, which exchange materials with their environment through metabolic processes. Nonetheless, a substance is supposed to be wholly present at different times or – to use the formulation of Endurance Theory that I have defended in chapter 1 – to have incompatible properties as non-relational properties. That being said, one must grant that a compound substance is (at every time t) different from the aggregate of its material constituents (at t), although the substance is made up of those constituents and it is exactly co-located with their aggregate. The main goal of a theory of substances is to assess which kind of entity is suitable for such a role.

The question that I have just formulated is often eluded just by stating that a (compound) substance is something over and above its material constituents. This slogan has an undeniable intuitive appeal, but it is not precise enough to be discussed at face value. Furthermore, in this crude form it raises an embarrassing question: usually, we are willing to identify the proper parts of an object with (all and only) its material constituents, but then how can an object be something over and above its material constituents, if it has no other parts beyond them? To use the jargon of contemporary mereology, this view clashes with the Principle of Weak Supplementation, which states that if x is a proper part of y , then y has some proper part disjoint⁴⁶ from x . To put it in a less formal but more vivid way, if x is not exhausted by y , then x must include something beyond y : this seems like a

⁴⁶For any x and y , x and y are mereologically disjoint if and only if they do not share any parts.

platitude.

On closer inspection, this clarification of the reservations leaves us with a clarification of the position itself: to state that a compound substance has no other parts beyond its material constituents amounts simply to rejecting the Principle of Weak Supplementation, because there is some entity – some compound substance – that is not identical to the sum of all and only its proper parts. Moreover, the Principle of Weak Supplementation is entailed by the Principle of Strong Supplementation⁴⁷, so the denial of the former requires the denial of the latter: the Principle of Strong Supplementation states that if x is not part of y , then y has some part disjoint from x . This assumption also seems very plausible: intuitively, it means that if x is not part of y , then x must include something that makes a difference in respect to y .

Of course, one might refuse to reject those standard mereological principles insisting that a substance is, in some sense, something over and above its material constituents, but that would not add anything to the debate: this non-standard part-whole account seems to be the price to pay to endorse a clear formulation of the something-over-and-above theory. This cost could raise strong perplexities, because the mereological principles above have a strong intuitive appeal – and they are embraced by many metaphysicians; nevertheless, in what follows I will take this theoretical option seriously.

2. The Hylomorphic Theory

As I have said in section 1, a compound substance such as Socrates, being an integrated whole, is unified by certain stable features, which one might take to be his *essential* features. Actually, it seems that those properties are what makes Socrates something over and above his proper parts. With this in mind, a natural move for substance theorists is to invoke a global organization, a “... whole ensemble of ... properties” (Oderberg 2007: 17), that gives a compound substance its integration and its essential features, and which in the Aristotelian tradition is called *form*: the resulting view is that a compound substance is a form or, alternatively, a composite made up of a form and a certain collection of matter or material constituents. That form is, ultimately, what makes a compound substance

⁴⁷To put it more formally, the Principle of Weak Supplementation can be proved within a formal system including the basic axioms for parthood (reflexivity, antisymmetry, and transitivity) together with an axiom for the Principle of Strong Supplementation. See Simons 1987 for a comprehensive survey of formal mereology.

something over and above its proper parts.

Among contemporary defenders of Hylomorphism, it is controversial whether forms are to be taken as primitive, *sui generis* entities or instead to be analyzed in more basic terms. For example, Koslicki (2006) has proposed to identify the form of a substance with its structure – namely, an entity linked to properties and relations exhibited by constituents occupying the roles made available by the structure itself⁴⁸. The plainest example is offered by chemical compounds, whose structures – as standardly represented, in chemistry, by means of structure formulas – involve both the elements entering in them and their spatial arrangement through certain bonds. Actually, Oderberg has argued in a convincing way that forms – if they exist at all – cannot be reduced to structures (2014b). Indeed, the individuation of the structure of an object is only relative to a certain level of description: water has a molecular structure involving certain chemical atoms put in certain bonds, but what about the sub-atomic structures of those atoms? Why shouldn't those be included in the “real” structure of the molecule? To select one level of description as the only metaphysically relevant one would be arbitrary, so it seems that a substance does not have a unique structure to be identified with. This objection becomes even more compelling when one takes into account living beings, whose organisms involve a highly complex hierarchy of structural levels. In conclusion, forms seem to have an irreducible, non-structural nature: in what follows, I will consider this primitivist version of Hylomorphism.

3. Compound Substances and Mereological Essentialism

One must note that both the hylomorphic theory and the something-over-and-above theory are incompatible with Mereological Essentialism, which is the view that, if x is part of y , then x is essentially part of y . Given that a compound substance like Socrates changes its material constituents over time, it seems that there is some x that is part of Socrates at certain times but not at other times; therefore, *a fortiori*, x is part of Socrates (at some time) and nevertheless it is possible that Socrates exist without having x among its parts. However, in the contemporary debate, Mereological Essentialism has been defended even by substance theorists such as Chisholm (1973), who claimed that one can find antecedents

⁴⁸Apart from her own theory, sometimes Koslicki also seems to propose this view as a plausible interpretation of Aristotle's hylomorphism. This exegetical proposal has been criticized by Marmodoro (2013) on the grounds of textual evidence.

of this view in Abelard⁴⁹ and Leibniz⁵⁰.

Apart from its illustrious historical and contemporary antecedents, this kind of substance-theoretic Mereological Essentialism has without doubts some intuitive appeal: in everyday talking, sometimes we mean by “part” an important and indispensable constituent of something. Nonetheless, this linguistic evidence is not to be taken too seriously, because our pre-theoretical intuitions are often shaky and incoherent: for instance, outside philosophical debates we are naïve endurantists and we are used to thinking that the material constituents of an object are parts of it, but, as I have shown above, a theory including these two claims together with mereological essentialism is inconsistent. Once one has assumed the existence of compound substances, one can avoid this inconsistency by denying mereological essentialism or by arguing that, strictly speaking, the material constituents of an object are not parts of it. If one of the two assumptions must be rejected, I see no reasons to favour Mereological Essentialism. Actually, the whole problem can be easily dismissed as a merely verbal one: given a substance *a*, the mereological essentialist reserves “_ is part of *a*” only for those that the opponent would say “_ is an essential part of *a*” of. On the other hand, the essentialist could say only “_ is a constituent of *a*” of those objects that the opponent says “_ is part of *a*” of. For instance, Chisholm himself accommodated his Mereological Essentialism by dismissing the material constituents of a substance as “parts in loose sense” of that substance, which sounds like a merely verbal move.

Of course, I cannot rule out in principle that there might be independent arguments in favour of Mereological Essentialism, but its *prima facie* appeal is not strong enough to make it a serious constraint on a metaphysical theory: we should not demand that a metaphysical theory is compatible with Mereological Essentialism. Therefore, I do not consider its rejection to be a weakness of these theories.

To sum up, the something-over-and-above account avoids peculiar ontological commitments at the cost of adopting a non-standard part-whole theory, whereas the hylomorphic account avoids such a heterodox solution by postulating forms as *sui generis* entities. It seems to me that these different strategies do not favour one option instead of the other, so in the rest of my inquiry, I will consider both the theories worthwhile.

⁴⁹ Abelard defended a view along the lines of mereological essentialism in his *Dialectica* (1970, 344.34-35, 550.36-551.4, 560.34-561.2); see Arlig 2013 for a historical study of Abelard’s view in the context of medieval mereology.

⁵⁰ The view that the whole cannot continue to exist if it loses one of its parts is suggested by Leibniz in the *New Essays on Human Understanding* (1765/1996: 238).

4. Connecting Levels

To put it in conditional terms, I claim that if there are compound substances, they are of the kind theorized by the something-over-and-above theory or by the hylomorphic theory; for brevity, I will refer indifferently to both of them as *Substance Endurance Theory* – which is, indeed, the most popular version of Endurance Theory. In what follows, I will argue that this version of Endurance Theory raises problems that are hard to solve. Given that it is the only plausible candidate as an account of compound substances, such difficulties provide a *reductio ad absurdum* of the existence of compound substances *tout court*. Therefore, there are no compound substances.

In what follows, I will sometimes talk, for the sake of simplicity, as if there were a bottom level of mereological simples – objects with no proper parts – that make up all the higher-level objects. Indeed, this picture is not to be taken for granted: in the last few decades, philosophers have argued for the metaphysical possibility of the so-called *atomless gunk*, an infinitely divisible stuff having no atomic parts. If that is possible, then there is no reason why a world made up only of gunk should not be metaphysically possible as well: such a world would be, indeed, a world with no mereological simples.⁵¹ Furthermore, in the history of science, many physical theories supposed to be fundamental were replaced by theories supposed to be even more fundamental: that said, one could be sceptical about reaching a bottom. Given this scepticism, one could count the possibility of gunk and that of a gunky world not only as metaphysical possibilities, but as epistemic possibilities too: maybe the actual world is gunky⁵². This eventuality would imply that there is an infinite descent toward lower and lower mereological levels, without ever reaching a bottom level.

A bit of semi-formal jargon is going to be useful here. I will use the phrase “level” to refer to a certain domain of objects; to be more formal, one might stipulate that a level L is an ordered pair $\langle O_L, P_L \rangle$, with O_L being a set of objects and P_L being a set of properties

⁵¹In contemporary debate, the possibility of atomless gunk and of a gunky world has been first brought out by Lewis (1991: section 1.8). A historical example of a metaphysical theory stating that the actual world is gunky is offered by Anaxagoras’s cosmology, particularly the thesis summarized with the slogan *there is something of everything in everything*; see Mathews 2002 and Sisko 2005 for a discussion of the puzzles raised from this view.

⁵²This line of reasoning has been endorsed by Sider (1993) and Schaffer (2003).

exemplified by the members of O_L . A mereological level L_1 is higher than another level L_2 if and only if (i) no objects of L_2 has objects of L_1 as proper parts, and (ii) at least some (possibly all) objects of L_1 have objects of L_2 as proper parts; L_1 is lower than L_2 if and only if L_2 is higher than L_1 . By “bottom level” I will refer to the level that has no lower levels; informally, the bottom level is represented by the domain of mereological simples together with the properties that they exemplify. That being said, I will stay agnostic about there being a bottom level.

After these preliminary discussions, I come to my argument against Substance Endurance Theory. I want to start with a depiction of the disagreement between an eliminative endurance theorist and a substance endurance theorist. Take the world as it is viewed by the former and the world as it is viewed by the latter: according to the first picture, at every time there is only an arrangement of simples put in certain spatial relations that bear certain properties; all the facts concerning their aggregates are determined by that arrangement, and that’s all. According to the second picture, there is something more: at a certain level, new objects arise: those objects – at every time they exist – are distinct from the aggregates of their material constituents, even though they are co-located with them. However, it seems that composition and co-location are not accidental: rather, substance theorists will want to claim that they depend on deeper metaphysical facts. In what follows, I will argue that the defenders of Substance Endurance Theory have a hard time accounting for those deeper metaphysical facts.

5. Strong supervenience

One possible strategy is to maintain that the arrangement of compound substances is determined by lower-level objects, and that such a determination is to be analysed simply in terms of *supervenience* of higher mereological level on lower levels. I will say that two possible worlds are indiscernible at level L iff, at every time, they have exactly the same distribution of properties and relations at L . (One might analyze the distribution of properties and relations at a certain level by invoking an ontology of facts, but here I will stay agnostic about the existence of facts or other object-cum-property compounds.) Finally, when I say that level L_1 is supervenient on level L_2 , I mean, as usual, that there are no possible worlds indiscernible at level L_2 but different at level L_1 . Given this apparatus, substance theorists might claim that every level is supervenient on the lower ones; this also

applies to levels that include compound substances, which entails that facts about compound substances supervene on lower-level facts as well.

Is the concept of supervenience suited to account for this kind of metaphysical determination? Let us have a look at the most uncontroversial instances of supervenience. The supervenience of, say, the shape of an aggregate of simples on the spatial arrangement of those simples is self-evident: for instance, it is not conceivable that there are worlds indiscernible at the bottom level with different facts concerning such geometrical features. This supervenience obtaining does not need to be further defended: by contrast, the burden of proof would fall on somebody who wants to argue that such a supervenience does not obtain. The same goes for intrinsic compositional properties such as *having 3 electrons*, or for structural properties involving both geometrical and compositional features such as *having 3 electrons arranged in such-and-such way*. To sum up, geometrical-structural properties are supervenient on the lower levels in the most robust way that one can think of.

Maybe this claim is less straightforward when one takes emergent dispositions into account: one could say that it is conceivable that many molecules of water, taken together, do not have liquidity; after all, the standard way of characterizing the epistemic feature of emergence is to say that emergent phenomena cannot be predicted from lower-level laws and processes. Nevertheless, it becomes clear that even these features are strongly supervenient on lower levels once you consider that many objects have, collectively, all the properties emerging from the properties of the single objects: this is nothing but a truism, because of the very concept of emergence. That being said, two aggregates of simples indiscernible at the bottom level cannot be different in their emergent features and globally there are no possible worlds that are indiscernible at the fundamental levels without having the same emergent features too.

Now we can bring out the distinguishing traits of this stronger kind of supervenience: in what follows, I will name it simply “strong supervenience”. The requirements for the supervenience of level L_1 on level L_2 being strong are both metaphysical and epistemic: L_1 is strongly supervenient on L_2 if and only if (i) L_1 is supervenient *simpliciter* on L_2 , (ii) the arrangement of L_2 provides a complete explanation of the arrangement of L_1 and (iii) it is not conceivable that two worlds are indiscernible at L_2 but different at L_1 . Needless to say, the concept of explanation might be analysed at length, but I am confident that it is clear enough for the present purposes: as far as we are concerned, an explanation can be taken to be an answer to a question of the form “Why is it the case that p ?”; with this in mind, a

complete explanation is an exhaustive answer to the relevant why-question. Given this clarification, one can see that the requirements (ii) and (iii) are entangled: if the arrangement of L_2 provides a complete explanation of the arrangement of L_1 , then it is not conceivable that two worlds are indiscernible at L_2 but different at L_1 , because L_2 being a certain way already excludes certain arrangements of L_1 . Now we can see why the geometrical-structural and emergent features considered above fit the requirement for being strongly supervenient on lower levels: once we have taken into account all the facts involving lower level, we have *ipso facto* a complete explanation of those features. For the same reason, one cannot conceive that the very same arrangement of simples does not give rise to the same features.

By contrast, the arrangement of compound substances cannot supervene on the arrangement of lower-level objects in the strong way seen in the cases above, because lower-level facts alone would not be sufficient to explain that. Hylomorphism does not explain why certain aggregates of lower-level objects are unified by a form. Likewise, if one endorses the Something-over-and-above view, it does not explain why there are compounds that, so to speak, exceed their proper parts, violating the Principle of Weak Supplementation. On the epistemic side, it is at least conceivable that there is a world where there are no forms or, alternatively, no objects over and above their proper parts, but only a distribution of mere aggregates. It seems that substance theorists cannot rely only on supervenience. But then, how is the distribution of whatever level of compound substances determined by the lower levels? To make their view satisfactory, substance endurance theorists need some other tool or postulation.

6. Invoking Laws

One strategy available is to invoke metaphysical laws connecting ontological levels: a compound substance of a certain kind (e.g. a human being, an oak, a carbon atom) being co-located with lower-level objects arranged in certain ways is a metaphysical law. As I have argued above, the properties of lower levels objects alone are not sufficient to determine high-level compound substances: if one treats laws as objects displaying their causal powers, one cannot vindicate the supervenience of compound substances on the fundamental level. It seems that substance endurance theorists need to claim that laws are basic features of the world: objects do not behave in a lawlike way because of their

properties, but because of brute nomic facts, and those nomic facts are necessary. In particular, the laws that link objects from different ontological levels do not depend on the properties of the objects involved, but they are in some way “put over them” and govern them. The resulting view is that (i) laws are non-reducible, *sui generis* entities that govern becoming⁵³, and (ii) there are special laws connecting the arrangement of compound substances to that of lower-level objects. This reconstruction enables us to better understand why this alleged supervenience does not fit the conditions for being strong: it does not satisfy the metaphysical requirement because the complete explanation of the arrangement of compound substances is provided not by the arrangement of lower-level objects alone, but by their arrangement together with those laws.

Likewise, it does not satisfy the epistemic requirement because it is at least conceivable that there is a world with the same arrangement of simples where such laws do not hold and there are no compound substances. Substance endurance theorists are claiming that nomic facts are distinct by the facts involving the objects ruled by that laws: here there are those particular facts, above them there are the laws. That being said, they must allow at least that one can recombine them in different ways, conceiving a scenario where at a certain level the same facts obtain, but some or all of those laws are removed and the higher-level facts are different. Granted that a world devoid of these laws is conceivable, substance endurance theorists cannot defend their necessity by arguing that a world without them is inconceivable; at the best, they can claim that this view has the advantage of regimenting certain pre-theoretical intuitions about the relationship between compound objects and their constituents. With this in mind, we have to assess how satisfactory this regimentation is.

7. *Ad Hoc* Laws?

The metaphysical commitment of this view must not be underestimated. Suppose that substance endurance theorists are willing to embrace an abundant substance ontology allowing for every kind of object posited by either common sense or special sciences⁵⁴: given that furniture, there are laws concerning *Homo sapiens*, laws concerning *Quercus petraea* (sessile oak), laws concerning carbon dioxide molecules, laws concerning clocks

⁵³Such an account of laws has been actually defended by Maudlin (2007).

⁵⁴Such a prodigal ontology has been defended, for instance, by Elder (2004).

etc...; generally, there is at least one law for every kind of compound substance.

This picture not only posits a plethora of brute metaphysical laws, but those laws also seem arbitrary. Let us consider human beings: what kind of law can account for their determination by lower mereological levels? Maybe a law linking human beings to a certain range of arrangements of lower-level objects. At a first look, these laws seem merely enumerative: they put together a range of suitable material bases $b_1, b_2 \dots$ and b_n and say that where there is one of $b_1, b_2 \dots$ and b_n there is a compound substance of a certain kind made up of it.

Substance endurance theorists might object that when I say that those material bases are “put together” by laws I am ignoring certain platitudes, because, for instance, the material basis constituting human beings share nontrivial features: a law about them is not enumerative, but it obtains for all entities that share certain natural features. Indeed, one might be tempted to answer: “Of course they share nontrivial features: they are all human beings!”. However, substance endurance theorists cannot accept this plain answer: they can only say that they constitute human beings. But this would make the required metaphysical laws empty: their sentential formulation would simply state, for instance, that human beings are locally supervenient on the arrangement composing a human being. It seems that substance endurance theorists are positing *ad hoc* laws just to retain Substance Endurance Theory: unless one is strongly biased in favour of that view, those principles are not plausible candidates as irreducible metaphysical laws.

8. Supervenience Reloaded

Since the strategy considered above does not work, substance endurance theorists might try to claim that, on closer inspection, compound substances are determined by lower levels in a strong way too, and they might try to explain why by enriching their philosophy of nature. Suppose, for the sake of exposition, that the world has a bottom level of mereological simples, which happen to be elementary particles. Given this furniture, one might claim that, besides the properties studied by physics (mass, charges, etc...), elementary particles have another class of properties, which could be named *poietic properties*. These poietic properties are dispositional: their manifestation is displayed only at higher levels and consists in making a certain compound substance exist.

To put it in a straightforward way, simples are disposed to bring into existence a

compound substance of a certain kind if they are put in certain arrangements, and that's all. The higher levels are linked to the fundamental one by upward laws that are nothing but a special kind of laws of nature. This strategy restores strong supervenience on the lower levels: once we have included poietic properties among the intrinsic properties of objects, their arrangement provides a complete explanation of the distribution of compound substances, because it also involves the simples displaying their poietic properties by bringing into existence compound substances of certain kinds. Likewise, it is not conceivable that there is a world where poietic properties are put in the right arrangements and, nevertheless, they do not give rise to compound substances, because that would be in conflict with the very concept of a poietic property. The difference between this strategy and the one examined in section 8 lies in their underlying views of laws: according to the strategy examined in section 8, laws are non-reducible, *sui generis* entities; according to the present strategy, laws are simply the displaying of natural properties of objects.

I am willing to grant that maybe a world where simples have such poietic properties is metaphysically possible, but how likely is it that our world has such a furniture of properties? To assess how satisfactory this solution is, we must consider the directedness of dispositions, i.e. their being directed toward a certain manifestation⁵⁵. The manifestation of these poietic properties consists in the production of a compound substance of a certain kind if put in a certain environment, i.e. a certain overall arrangement of simple activating that disposition. Some contemporary metaphysicians have highlighted the analogies between the directedness of dispositions and mental intentionality: for example, both are directed toward something that is beyond themselves, which is a manifestation for dispositions and an object of thought for mental states. Moreover, an object can bear a disposition without actually manifesting it, as some mental states seem to have a non-existent intentional object: I can think of Pegasus or Tristram Shandy even if they do not exist⁵⁶. The extension of a properly intentional character to dispositions and the concept of physical intentionality are controversial: indeed, one might suggest that they are nothing more than metaphors. However, for the purposes of the present paper I do not need to discuss these questions: whatever its grounds are, this intentional discourse is useful to give an intuitive account of the interaction between objects with certain dispositions and the surrounding environment.

⁵⁵See Martin 1997 for a systematic treatment of this issue.

⁵⁶A comprehensive examination of the analogies between the directedness of dispositions and mental intentionality is offered by Molnar (2003: Ch. 3).

The problem with the present hypothesis is that the intentional complexity attributed to simples is unbelievable: they are directed to a great range of manifestations, because they can produce a great variety of compound substances depending on the environment they are put in. Furthermore, each simple seems to have an exceptional sensitivity to a rich space of changes of the environment it is put in. Consider a human being and entertain the reasonable assumption that a living being passes away by dying: relatively small differences in a bleeding can make the difference between life and death. To each condition corresponds a great range of micro-physical arrangements; nevertheless, the simples are supposed to be capable of detecting the variations in those arrangements and continue to determine a compound substance or not according to them.

Moreover, there is something in the very nature of endurance that would make the directedness of these putative dispositions even more suspicious. Suppose that such dispositions can successfully account for the rise of a new object that is numerically distinct from the sum of its material constituents; the metaphysical *explanandum* we are discussing requires something more: not only do the simples displaying those dispositions make a human being exist, but they must make the same human being exist (at different times). After the event that makes the compound substance come into being (e.g.: the formation of certain chemical bonds or, maybe, the fertilization of an egg cell by a sperm cell), the subsequent events should make it continue to exist by preserving its identity over time. Here this model becomes untenable, because it cannot explain why simples conserve Socrates instead of making other human beings come into being: they should have indeed a special sensitivity to the previous states of the universe.

To sum up, the postulation of poietic properties looks like a *virtus dormitiva* move: substance endurance theorists would be attributing special, *ad hoc* features to the world just to find a place for compound substances. Substance endurance theorists might reply that my reservations go too far, because they apply to standard scientific explanations too: for example, one could say that elementary particles have the disposition to ground liquidity if put in a certain arrangement, acidity if put in another one etc.... If one takes my reservations seriously, the whole scientific enterprise – at least as we know it – fails. My rejoinder is that there is a substantial difference in the underlying explanatory strategy: in scientific theorizing the dispositions belonging to level L are not described by simply linking them to the emergent properties (belonging to level higher than L) that they determine, but by describing how they work at level L. That being said, the properties emerging at higher levels can be explained by appealing to that of L: each level gives an

account of the higher one and at the end, maybe, we arrive at a bottom level.

This picture might seem physicalist and thus committed to a dated philosophy of science, but it is not: I am not supporting the project of the reducing all the higher-level explanations to explanations in fundamental physics. Instead, I am stressing the synergy between different levels of explanation: each level explains a certain domain of phenomena and each higher level is explained by the lower ones.

9. Isn't Grounding Enough?

Substance endurance theorists might try to avoid all the troubles above with supervenience, special laws of nature, and special dispositions by relying on the concepts of grounding or metaphysical priority/dependence. Prominent advocates of those concepts – such as Schaffer – have argued that they are basic metaphysical tools, which are not analyzable in terms of more basic concepts (2009a). With this in mind, a substance endurance theorist might argue that the grounding relation between compound substances and their simple parts is sufficient to provide us with a complete explanation of the determination of compound substances from their lower-level constituents: a certain distribution of simples grounds a certain distribution of compound substances, and that's all.

My reply is that appealing to grounding in this way is only a disguised way to invoke the metaphysical laws that I have already discussed in section 8: talking about grounding is only a shorthand for certain lawlike connections between lower-level objects and higher-level substances. Those connections are going to face the difficulties that I have already discussed.

The other problem with this strategy is that it goes against the spirit of substance ontology, which is to maintain that some compound objects do not depend on their proper parts in any metaphysically robust sense. Whether they prefer Hylomorphic View or the Something-over-and-above View, substance endurance theorists are committed to the claim that some compound objects are something over and above their proper parts, which is hardly compatible with the claim that those compound objects are grounded by – or depend on – their proper parts. To work out this strategy in a consistent way, substance endurance theorists would need to distinguish between two kinds of dependence: the first one is (i) the kind of dependence of the proper parts of a compound substance on the whole substance, which can be taken to be the same kind of dependence as that of tropes on the

objects that they belong to, or that of sets on their members. The second kind of dependence is (ii) the kind of dependence of a compound substance on its proper parts. Given this distinction, it would be logically consistent to maintain that a compound substance is prior its proper parts in virtue of the first kind of priority/dependence, but it depends on its proper parts in virtue of the second kind.

Though being logically consistent, this would look like a distinction without a difference, especially if both of those concepts of dependence are taken as primitive and undefined: here, it is clear that substance theorists need two concepts two theoretical roles, but it is not clear whether there are actually concepts suited to play those roles. It is hard to see how those could be explicated in an informative way. As a further alternative, substance theorists might grant that compound substances are not prior in any way to their proper parts, even if they are not reducible to the mere aggregate of those parts. This position would be consistent too, but it would make compound substances metaphysically ephemeral, because they would not play any explanatory role in respect to their proper parts. By contrast, substance theorists want to attribute to compound substances a "... 'top-down' influence..." on their lower-level parts (Oderberg 2007: 16). Generally, the troubles for substance endurance theorists come from the fact that they claim that some compound objects are something over and above their proper parts, but on the other hand they have to account for the determination of those compound objects on behalf of their proper parts: invoking ontological dependence only makes their troubles more evident.

10. Substance Brutalism

Another strategy available to substance theorists is what might be called *Substance Brutalism*: according to this view, particular facts about lower-level objects making up a certain compound substance are brute facts. It is a brute fact that the objects $a_1, \dots, \text{and } a_n$ compose the substance A , it is another brute fact that $b_1, \dots, \text{and } b_n$ compose the substance B , and so on. Generally, for every collection of objects that compose a substance, there is a related brute fact – namely, the brute fact that those objects compose that substance.

This view might be seen just as a way to bite the bullet: a substance theorist who endorses this view is actually acknowledging that there is no way to account for the rise of compound substances on lower mereological levels. But maybe it is unreasonable to demand a non-enumerative account: indeed, most metaphysicians will grant that every

metaphysical view has to posit a number of brute facts, which explain other facts but are not amenable to be further explained⁵⁷. To be sure, not all facts are equally suited to be a brute fact: some facts are arbitrary if taken as brute facts, whereas others are better suited. With this in mind, one might argue that those are reasonable candidates as brute facts: after all, isn't it a platitude that certain constituents compose this human being and those other constituents compose that apple tree? A platitude is, indeed, something that we are willing to accept without asking for an account.

To evaluate this manoeuvre, one has to keep in mind how the brute facts that we are concerned with are individuated: we are not concerned with there being ordinary objects, but with there being objects that are somehow something over and above their proper parts. Therefore, the brute facts that we are concerned with are not that there is a human being here, an apple tree there, and so on. Instead, those brute facts are that there is a compound substance here, a compound substance there, and likes. Those are neither platitudes nor general principles: those are basic facts about the metaphysical nature of things, yet they are particular. They have neither the obviousness of a platitude nor the comprehensiveness and the theoretical character of a general metaphysical principle: a view that takes them as brute facts would be simply arbitrary.⁵⁸ Of course, I cannot exclude that a more detailed account of bruteness might show that, all these considered, those are kosher as brute facts. I am willing to grant that, but in the meanwhile, we have good reasons to dismiss Brutalism.

Summary

In this chapter, I have shown that all the attempts to account for the determination of compound substances by their lower-level proper parts lead to *ad hoc* manoeuvres; by contrast, Substance Brutalism dismisses from the start the demand for such an account, but the resulting view also relies on *ad hoc* assumptions. I take this as a *reductio ad absurdum* of Substance Endurance Theory. Some substance theorists will still stick with their intuition that some compound objects are something over and above their proper parts, but

⁵⁷ A remarkable exception is represented by Dasgupta (2016), who explores the view that there are no brute facts, because each fact is either explained by other facts or explained by itself.

⁵⁸ One might try to vindicate this strategy, arguing that, once we reject the existence of compound substances, there are no objects suited to be ordinary objects, such as human beings or apple trees. I will consider this line of reasoning in chapter 8, when I will be defending my view from some obvious objections.

they must either face the difficulties that I have highlighted or find some novel way to regiment that intuition.

Chapter 6. Dependence, Individuation, and Gunk

Introduction

There is a bottom level of mereological simples, and all compound objects are ultimately made up of those simples: in spite of having illustrious historical antecedents and being suggested by the search for a bottom level in fundamental physics, this picture is not taken for granted in contemporary metaphysics, and it is rarely defended. By contrast, an assumption that has played a tacit and uncontested role in recent debate is the possibility of so-called *gunk* or, better, of gunky objects – namely, objects that have no simple parts⁵⁹. To put it in a more vivid way, a gunky object is an object whose decomposition into proper parts never ends. Likewise, a world is gunky if and only if it contains only gunky objects and no simples. Gunk is widely considered to be at least *prima facie* metaphysically possible: it seems that in some possible worlds there are gunky objects and that some possible worlds are entirely gunky. The claim that gunk is epistemically possible has been defended too: for instance, Schaffer observes that there are “... scientifically serious... empirically open hypotheses” (2010a: 62) that posit an infinite regression toward lower and lower levels, such as Dehmelt’s infinite regression of sub-electron particles (1989) or Georgi’s infinite quantum field regression (1989). Therefore, as far as we know, it might be the case that the actual world lacks a bottom level, and that the descent toward lower and lower layers actually goes on *ad infinitum*.

As far as I am aware, no contemporary philosopher has ever argued for the actual existence of gunky objects⁶⁰. Nevertheless, the metaphysical and epistemic possibility of gunk is often invoked as a test for metaphysical views: a metaphysical view excluding the existence or the possibility of gunk is considered to offer a case against that view. For instance, Sider (1993) makes such a case against Van Inwagen’s (1990) view that the only compound objects are living things: if no object is mereologically simple, then it seems that there are also compound objects that are not living things. Likewise, Schaffer (2007)

⁵⁹In contemporary analytic metaphysics, the possibility of atomless gunk and of a gunky world has been first brought out by Lewis (1991: 20-1).

⁶⁰On the other hand, a historical example of a metaphysical theory stating that the actual world is gunky is arguably offered by Anaxagoras’s cosmology: for a discussion of the problems arising from this interpretation of Anaxagoras’s thought, see Mathews 2002 and Sisko 2005.

has argued that one of the virtues of priority monism is that, differently from alternative views of fundamentality, it is compatible with the possibility of an infinite descent. On the other hand, the attempts to build an argument against the possibility or the actuality of an infinite descent have been scant in the recent literature⁶¹: I will show that such an argument can be built by assuming Mereological Fundamentalism – namely, the view that all compound objects are mere sums.

In chapter 5, I argued against the existence of compound substances – namely, enduring compound objects that are something over and above their proper parts. In this chapter, I will consider the alternative view that all compound objects are mere sums – namely, objects that are nothing over and above their proper parts: I will call this view *Mereological Fundamentalism*. In the first part of this chapter, I will assume Mereological Fundamentalism as a working hypothesis, whereas in the final sections I will assess how it stands with respect to alternative views of the relationship between parts and wholes.

Mereological Fundamentalism is a standard option in contemporary metaphysics: it has been variously stated as the claim that a whole “... is nothing over and above its parts” (Lewis 1991: 80), that a whole has no “... additional existence” (Baxter 1988: 579) over its parts and that a whole is “... identical to its parts collectively” (Baxter 1988: 580). Overall, it is easy to grasp the spirit of those slogans, and many have been seduced by them. On the other hand, to give a clear formulation of this view is not that easy. To fix a bit of terminology, I have phrased Mereological Fundamentalism as the view that every compound object is a mere sum, but this simply reframes the problem: the main concern about Mereological Fundamentalism becomes to assess what a mere sum is. The most promising strategy seems to invoke the concept of ontological dependence: a compound object is a mere sum if and only if it depends on all of its proper parts (Schaffer 2009a: 374). As a result, Mereological Fundamentalism is to be formulated as the view that every compound object depends on its proper parts. In the next part of the chapter, I will regiment this view by articulating an account of ontological dependence, and then I will show how a version of Mereological Fundamentalism based on that account can be used to argue against infinite descent.

1. Mere Sums and the Argument from Ontological Dependence

⁶¹As we will see, one of the few examples is offered by Cameron (2008).

In the previous section, I have formulated Mereological Fundamentalism by employing the concept of ontological dependence. The legitimate worry with this approach is that it is not so clear what this dependence amounts to, and the prospects for an explication might look dark, given that many contemporary metaphysicians are inclined to take ontological dependence and akin relations such as grounding as primitives. For now, I will just take ontological dependence as a useful notion to work with, and later I will work out a definition of it.

Now, I will introduce a promising argument against infinite descent, namely the *Argument from Ontological Dependence*, which originated with Leibniz (1989: 69-90) and has been recently dusted off by Cameron (2008)⁶². I will show that, as it stands, this argument is not very compelling, but it can be improved by adopting a certain account of ontological dependence.

The first premise of the Argument from Ontological Dependence is that (1) all compound objects depend on their proper parts. The second premise is the so-called *Principle of Well-foundedness*: (2) every dependence chain is finite, i.e. has a last member that does not depend on any other entity. The conjunction of those two assumptions rules out gunk: if there were gunky objects, then their decomposition into parts would never end up with simples, and thus some dependence chain would go on *ad infinitum*.

Premise (1) just is the formulation of Mereological Fundamentalism that I have adopted provisionally. With this in mind, we need to assess the plausibility of the second premise, which is the Principle of Well-foundedness: is there any support available for such a principle? Cameron acknowledges that the main reason to embrace it is provided by the brute intuition that every chain of dependence *must* stop somewhere. In a similar vein, Leibniz observes that “... every being derives its reality only from the reality of those beings of which it is composed, so that it will not have any reality at all if each being of which it is composed is itself a being by aggregation...” (1989: 85). As Cameron himself acknowledges, these considerations explicate the intuitions that underly the Principle of Well-foundedness instead of providing argumentative support for it: if one does not share those intuitions, the very Argument from Ontological Dependence is worthless.

To make the Principle of Well-foundedness palatable also for those who do not share such intuitions, Cameron attempts a further defence by resorting to an abductive argument:

⁶²It is worth noticing that here Cameron does not deal primarily with gunk, but with more general issues concerning ontological dependence.

the view that every dependence chain is finite has, he claims, an explanatory advantage, since “it would be better to be able to give a common metaphysical explanation for every dependent entity” (2008: 12). In absence of any definition or explication of ontological dependence, it is not clear what explanatory gain this relation is supposed to offer; however, I am willing to grant that it has some. That being said, I object that the absence of a fundamental level would not undermine that gain: what we cannot do if some dependence chain goes on infinitely is taking any particular entity and completely track its dependence chain to a set of fundamental objects, but why should we care about tracking such a chain? Metaphysics deals with the general aspects of reality, not with the ontic genealogy of particular entities. If there is no fundamental level, we can just acknowledge that some dependence chain has no end: that is all we need when we come to draw a metaphysical picture of the world. To put it briefly, an infinite descent involves no limitation in metaphysical explanation: therefore, positing a fundamental level is not to be taken as a theoretical virtue of a metaphysical theory.

Given that Cameron’s abductive argument is shaky, it seems that the Principle of Well-foundedness would have to be assumed as intrinsically plausible, in which case it does not offer a solid bedrock to build an argument against the existence of gunk. I suggest that what prevents the Argument from Ontological Dependence from being more convincing is taking the relevant relation of ontological dependence as a theoretical primitive: with this in mind, I will show that the overall argumentative strategy can be vindicated by defining the relevant kind of ontological dependence in terms of individuation. I will use that definition to establish that a certain kind of infinite descent is impossible, and that this impossibility also entails the impossibility of gunk.

2. Dependence as Individuation

My proposal is to define the kind of ontological dependence at work here in terms of individuation: an entity depending on some other entities consists in the former being individuated by the latter. At a first stage, this kind of dependence can be defined as follows:

Principle of Dependence: For any entities x and ys , x depends on ys iff x is individuated by ys .

The concept of individuation is amenable to further analysis. To use a semi-formal language:

Principle of Individuation: For any entities x and ys , x is individuated by ys iff there is a multigrade relation R such that, for any z , (i) if $x=z$, then $x=z$ because $R(x, ys)$ and $R(z, ys)$, and (ii) if $x \neq z$, then $x \neq z$ because $\neg R(x, ys)$ or $\neg R(z, ys)$.

Here I am taking individuation as *complete* individuation: in an instance of the Principle of Individuation, a certain entity is individuated by other entities collectively. If x is (completely) individuated by ys and z is one of the ys , one can say that x is partially individuated by z , or that z helps to individuate x .

Mere sums are individuated by their proper parts, so in their case, the relevant individuating relation is that of mereological composition: a certain mere sum is this mere sum instead of any other one because it has certain proper parts. If, *ex absurdo*, it had other parts, it would be another entity. In the light of the Principle of Individuation, we can see that individuation is a meta-ontological notion that comes in many varieties, each of which is characterized by a distinctive individuating relation. Since dependence is defined in terms of individuation, it follows from this that dependence comes in many varieties as well, which is not surprising given that it is supposed to be ontologically pervasive, obtaining between entities from various ontological categories.

Now I am going to show that this definition does justice to our shared intuitions about dependence/priority. First, we have already seen that it accounts in a straightforward way for our intuitions about the dependence of a mere sum on its parts. Something analogous can be said about other alleged cases of dependence. For instance, consider the set {Socrates} and its member Socrates, where the former seems to depend on the latter: the best justification for this is that a set is individuated by its member, and that the individuating relation, in this case, is the relation of set-theoretic containment, i.e. the inverse of set-theoretic membership. (It is worth noticing that the dependence on members holds only for non-empty sets: the empty set \emptyset is, arguably, individuated by itself, so it is a fundamental entity.⁶³) Likewise, facts are supposed to depend on the objects and the properties and relations that build them, and the most intuitive motivation for that is, again,

⁶³See Fine 1994.

that facts are individuated by their constituents: a fact made up by different constituents is *ipso facto* another fact. In this case, the individuating relation is the non-mereological composition facts are supposed to be structured by. Something analogous obtains for entities such as boundaries, which seem to depend on the objects that they delimit, since delimiting *this* particular object is what makes a boundary identical to this particular boundary⁶⁴; here the individuating relation is *delimiting*.

Besides accommodating the easy cases, this account helps to figure out the controversial cases as well. An instructive example is offered by the case of tropes. Those metaphysicians who posit irreducible – albeit not bare – substrata (Lowe 1998, 2006) maintain that tropes depend on the objects that they belong to, and the most intuitive support for this claim is that they are not transferable, i.e. that a trope could not belong to another object, since it is individuated by the object that it belongs to. By contrast, the defenders of trope bundle theory (Campbell 1990), who identify objects with bundles of tropes, seem to claim that an object depends on its tropes. According to the framework that I have worked out, this difference can be framed as that between two different accounts of the individuation order between objects and tropes. Substrata theorists maintain that the object to which a trope belongs helps to individuate that trope, but it cannot individuate it completely, since an object can bear many distinct tropes: at the most, a trope might be (completely) individuated by the object that it belongs to together with the universal property of which it is an instance, given that an object cannot bear more than one instance of a certain universal property at the same time. On the other hand, the defenders of trope bundle theory seem to assume that tropes are (partially) individuated by the objects to which they belong, because otherwise their picture would fall into a circularity. As Schaffer (2001) highlights, there is a certain tension in much work on trope metaphysics, since “... what one finds in virtually every presentation of trope theory is a gloss of the trope as the quality of a particular object...” (2001: 249), even if trope bundle theorists actually intend to take tropes as more fundamental than the objects that they belong to. This tension can be framed by employing my account of dependence: trope bundle theorists claim that objects are individuated by their tropes, but on the other hand, they talk as if tropes were individuated by the objects that they belong to. With this in mind, trope bundle theorists can emend their theory either by accepting that a trope is individuated by itself or by

⁶⁴All of these cases are taken from the inventory sketched by Koslicki (2012: 188-9). I want to stress that here I am not committed to the existence of any of those entities: I am only considering them to show that my account of ontological dependence accommodates them in an elegant way.

finding an alternative principle of individuation, such as that proposed by Schaffer himself, who suggests that tropes are individuated by their spatiotemporal location.

Another point in favour of this account of dependence as individuation is that individuation is suited to play the explanatory role that dependence is supposed to play. According to Cameron, if x is prior to y , then the existence of x explains the existence of y (2008: 9). It is clear that Cameron is not concerned with a *causal* explanation of the existence of objects, but with some kind of non-causal, metaphysical explanation. With this in mind, the spirit of his claim is, again, vindicated by the present account of dependence as individuation: the individuation of an entity e can be taken as providing a metaphysical explanation of the existence of e , in so far as it provides an explanation of which entity e is.

Incidentally, it is worth noticing that there are also cases of alleged ontological dependence where the dependence relation at work is not the one that I have defined: for instance, according to a broadly Aristotelian view of universals, the way a universal depends on the particulars that it is instantiated by cannot be analysed in terms of individuation, because the universal would exist even if exemplified by other particulars. With this in mind, I am not claiming that *every* kind of ontological dependence can be analysed in terms of individuation, but I hope to have shown that at least an important and pervasive kind of ontological dependence can.

To complete the illustration of this framework, one needs some explication of “because”, which plays such a vital role in the Principle of Individuation. To be sure, the sentential operator “_ because --” here conveys neither a causal explanation nor a logical or analytic explanation. For these reasons, I am inclined to think that it might express a primitive explanatory notion, which is reducible neither to causal connections nor to logical or analytic relations. An alternative answer is that “_ because --” might be further analysed in terms of grounding, in particular factual grounding, which is supposed to be a relation obtaining between facts: for instance, the fact that there are certain chemicals in a region of space is grounded by the fact that there are particles arranged in a certain way in that region of space. If this analysis is correct, then individuation may be ultimately reducible to factual grounding. Some philosophers have alternatively tried to accommodate certain cases of individuation by resorting to the notion of essence: for instance, one might say that it is part of the essence of {Socrates} that its unique member is Socrates⁶⁵. But, as highlighted by Koslicki, such a move is hardly explanatory, since talking in terms of parts of an essence already presupposes that the essence of a certain entity is constructed as

⁶⁵See Fine 1994.

including the dependence conditions of that entity (Koslicki 2012: 190-1): ultimately, that dependence remains unanalysed.

At the end of the day, are we forced either to take “_ because --” as a primitive operator or to take a factual grounding relation as a primitive notion to formulate the Principle of Individuation? I suggest that there might be a third alternative, namely to reformulate the Principle of Individuation as a counterpossible conditional – namely, a counterfactual conditional whose antecedent is necessarily false. An instance of such a counterpossible principle would have the following form:

If it was not the case that $R(a, bs)$ then it would be the case that $a \neq a$.

(Where R is the relevant individuating relation.) However, in that case, one needs a hyperintensional semantics for counterfactual conditions that, differently from the Lewis-Stalnaker one, does not entail that every counterfactual whose antecedent is necessarily false is trivially true. If such a reduction is adequate, then dependence can be defined through quasi-logical notions.

A conditional like the one above provides at least a criterion for individuation, since it matches the kind of *ex absurdo* reasoning that we usually employ to assess the individuation of dependent entities: for instance, we conclude that {Socrates} is individuated by Socrates because if it had other members it would be another set. That said, whether such a conditional can be taken as providing a definition of individuation as well is not obvious: it might be the case that it provides only a test, and that such a test works because of an irreducible grounding relation. For these reasons, I grant that at the end of the day the sentential operator “_ because --” or the factual grounding relation may be the primitive required to regiment the present framework.

3. Individuation and Fundamentality

With respect to the kind of dependence that I have just defined in terms of individuation, fundamental entities are those that do not need to be individuated by other entities, or, to put it in a different way, those entities whose individuation is brute, and consists in mere self-identity: a fundamental entity is individuated just by itself. Of course, the law of self-identity is a basic logical truth, which obtains for every entity: what is peculiar to

fundamental entities is that identity is also their individuating relation, so their being self-identical is all there is to say about their individuation.

Within the present framework, a substance can be defined as an object that is not individuated by other objects. This definition entails that substances are somehow fundamental as objects, since they are not individuated by other objects; but whether they are individuated by some other entities or not is still an open question. To be sure, the present definition is compatible with the view that substances are self-individuating, according to which, for any two substances x and y , if $x=y$, then this is the case just because $x=y$; if $x \neq y$, then this is the case just because $x \neq y$. According to this view, substances are fundamental entities *tout court*.

On the other hand, my framework is also compatible with bundle theory, as well as with the doctrine, first proposed by Duns Scotus, according to which every substance is individuated by a non-qualitative property distinctive to it – namely, its *haecceity*, the property of being *this* object rather than any other object. According to both of those views, substances are not fundamental, since they are individuated by other entities, although those individuating entities are properties instead of objects.

It is worth noticing that the framework that I am outlining is neutral with respect to composition: Mereological Fundamentalism says that every compound object is individuated by its proper parts, but it does not say under which conditions certain objects individuate another object, which is their mere sum. In particular, it does not entail that mereological composition is universal. Furthermore, it does not say whether the principles of composition are necessary or not: as stressed by Cameron (2007), it might even be the case that composition occurs under certain conditions in some possible worlds, and under different conditions in other possible worlds.

Given the present definition of ontological dependence in terms of individuation, one might employ the concept of dependence to define the stronger concept of derivativeness:

Principle of Derivation: For any entities x and ys , x is derivative from ys iff (i) x depends on ys ; (ii) for any entity z , if z is one of ys then $x \neq z$; and (iii) necessarily, if ys exist then x exists.

An entity that is derivative from other entities is, so to say, ontologically parasitic, or, to use Schaffer's words, already latent within the latter (2009a: 378). The postulation of derivative entities is the thing closest to what Armstrong famously called an *ontological*

free lunch. Necessitation is not sufficient for derivativeness: even if you are a kind of ultra-necessitarian theist and you think that God necessarily exists and necessarily creates the world as actually is, it is not the case that all created entities are individuated by God, so they are not derivative from him.

On the other hand, whether dependence is sufficient or not for derivativeness is a question that is likely to admit different answers for different categories of entities. For instance, an affirmative answer seems plausible in the case of (non-empty) sets: the existence of an entity x seems to necessitate the existence of the dependent singleton $\{x\}$, which is therefore derivative from x . On the contrary, the answer seems negative in the case of facts: the existence of Socrates and of the universal of whiteness does not necessitate the existence of the fact that Socrates is white, since it is possible that both Socrates and whiteness exist but the former does not exemplify the latter; therefore, the fact that Socrates is white is dependent on Socrates and whiteness but not derivative from them.

In the case of mere sums, the answer is harder to assess, because it is related to the debate about the conditions under which mereological composition occurs, and what its modal status is: we have seen that the present framework does not say anything about these issues. With this in mind, if universal composition obtains necessarily, then a mere sum is derivative from its proper parts, since the existence of those parts necessitates the existence of the mere sum that they individuate. On the contrary, if universal composition does not obtain or obtains merely contingently⁶⁶, then the existence of some objects does not necessitate the existence of their mere sum, so the latter is not derivative from the former.

The present distinction between dependence and derivativeness suggests a refinement of the loose idea that there are some entities such that to posit them does not involve any further theoretical commitment beyond that involved by positing other entities. According to my regimentation, the entities that deserve such a status are those that are not only non-fundamental, but also derivative from some other entities: once we have objects and properties, the postulation of facts made up by them involves a further commitment, whereas the postulation of impure sets having them as members does not. As we have seen, it is not obvious how things are for mere sums: contrary to what Armstrong famously stated, even if one endorses Mereological Fundamentalism it is not obvious that positing a compound object beside its proper parts is an ontological free lunch.

⁶⁶The hypothesis that the principles of composition might be only contingently true has been explored by Cameron (2007).

4. Infinite Descent and the Need for Ultimate Individuation

In the previous sections, I have worked out an account of dependence as individuation and then I have defended it by showing its theoretical virtues. In this section, I will show how this account can be used to sharpen the Leibniz-Cameron argument against infinite descent.

First, let us say that a set A is an individuation basis of the entity e if and only if e is (completely) individuated by the members of A : if x is individuated by y_1, \dots, y_n , then $\{y_1, \dots, y_n\}$ is an individuation basis of x . It is, I maintain, possible that an entity has many individuation bases. For instance, let us suppose that a trope f of F -ness is individuated by the object a in which it inheres: then the set $\{f\}$ is (completely) individuated by f , but also by a . In general:

Principle of Transitivity of Individuation: For any entities $x, y_1, \dots, y_n, z_1, \dots, z_n$, if x is individuated by y_1, \dots, y_n and y_1 is individuated by z_1, \dots, z_n , then x is individuated by $z_1, \dots, z_n, y_2, \dots, y_n$.

According to the present terminology, a fundamental entity is an entity whose only individuation basis is its singleton. Finally, let us say that an ultimate individuation basis of e is an individuation basis of e all of whose members are fundamental entities.

It seems that a mere sum has an individuation basis for any set of entities of which it is the mereological sum: the mere sum of a and b , where b itself is the mere sum of c and d , has both $\{a, b\}$ and $\{a, c, d\}$ as individuation bases. It is easy to see that a mere sum has an ultimate individuation basis only if it has an individuation basis all members of which are objects that are not mere sums: otherwise, those members would not be fundamental, and the individuation basis would be by definition non-ultimate. (Incidentally, it is not obvious that such an individuation basis is itself the ultimate individuation basis of that mere sum: one might argue that each of those objects is individuated by a certain *haecceity*, so the ultimate individuation basis of that mere sum is the set of the haecceities of those objects.) It is easy to see that, if all compound objects are mere sums, a gunky object does not have an ultimate individuation basis: a gunky object is a mere sum, each of its parts is a mere sum, each part of those parts is a mere sum, and so on *ad infinitum*. Since mere sums are not fundamental, the individuation of such a gunky object will never reach a basis of

fundamental entities.

To give a final verdict about gunky objects within the world depicted by Mereological Fundamentalism, we need to see what the lack of an ultimate individuation basis means. Let us say that an entity is determined if and only if it has some ultimate individuation basis, undetermined otherwise: what does being undetermined amount to? This question can be clarified by an analogy with sentences expressing no proposition, like self-referring sentences, such as the truth-teller: in those instances, it is not the case that the sentence has a truth-value that we are unable to assess; rather, it is the case that the sentence has no truth-value at all. We might decide to assign truth-value to it just by stipulation, but any such assignment would be arbitrary and would not correspond to any underlying semantic fact. Likewise, the failing in the individuation of an undetermined entity is not just an epistemic matter, but an ontological one: it is not just the case that an entity has an individuality that we are unable to grasp because of our practical or cognitive limitations; instead, it is not determined which entity that entity is. Given that sooner or later we need to stop and rest on a basic assumption, I stop here: I maintain that such undetermined objects are metaphysically impossible. If a scenario involves some infinite individuation chains, and hence some undetermined objects, that scenario is metaphysically impossible. According to Mereological Fundamentalism, a gunky scenario involves such a metaphysical absurdity, which is a reason to reject the possibility of gunk.

One might challenge this argument by replying that the very demand for an ultimate individuation is unmotivated: after all, identity is a relation that every entity trivially entertains with itself, and that requires no further ground. In particular, it seems that a mere sum is identical to itself just because that is logically true for every type of entity. This objection just misses the point, since I am not arguing that some entities need to be individuated by some other entities. What I am claiming is that this is the commitment of those of us who believe that reality is hierarchical, i.e. that some entities are prior to some other entities. In particular, this is the view that mereological reductionists need to endorse in order to work out their position: an ontologically flat world where every object is just individuated by itself is not a world where there are mere sums, but at the most a world where there are objects that have proper parts. At the end of the day, “Mereology is ontologically innocent...” (Lewis 1991: 81), but in a sense different sense from what Lewis meant: as we have seen in section 3, compound objects (even mere sums) may be or not be derivative upon their parts, but mereology alone does not say anything about that, since it is not concerned with priority and dependence.

Something analogous to the line of thought underlying my argument can be found in the foundations of set theory, particularly in the suspicions that set theorists have traditionally expressed about non-well-founded sets – namely, those sets that have an infinitely descending membership sequence. Consider the universal set: its existence has been widely considered to be counter-intuitive because, by definition, such a set is supposed to contain itself too. I suggest that what is (or at least seems to be) problematic with non-well-founded sets is that they lack ultimate individuation: particularly, the universal set is individuated by its members, but one of its members is the universal set itself, so its individuation falls into a loop. In general, an infinitely descending membership sequence qualifies as an infinite individuation chain. Standard set theories, like ZF, exclude such cases by assuming an Axiom of Foundation, which implies that there are no non-well-founded sets. The existence of such sets clashes with the so-called iterative conception of sets, that conception of sets that has its standard regimentation in ZF, and in which “We do not suppose that what we come up with after combining some elements into a whole could have been one of the very things we combine” (Boolos 1971: 220). Nevertheless, non-well-founded set theories have been developed as well in the last few decades⁶⁷. Within the present framework, those theories allow for sets that are not mere aggregates: although they follow the extensionality principle, they are not individuated by their members. I want to stress that, even if my argument against infinite descent assumes Mereological Fundamentalism, formulated as the view that every compound object is a mere sum, this does not entail that every set is a mere aggregate of its members. Therefore, Mereological Fundamentalism does not obviously conflict with realism about non-well-founded sets.

One might argue that quantum mechanics provides a case against my rejection of entities without a complete individuation: the received doctrine here is that two bosons or two fermions in a joint state lack individuality, since they are indistinguishable with respect to both their intrinsic and their relational properties⁶⁸. My reply is that, even if two particles are indistinguishable, this does not show that they lack individuation, but just that they are not individuated by their universal properties. That said, it may be the case that they have a brute individuation (i.e. each of them is individuated by itself), or that they are individuated by their particular properties (i.e. their tropes), or by their *haecceities*. Alternatively, one might claim that they are individuated by a certain relational structure, which is close to the view embraced by the defenders of so-called Ontic Structural

⁶⁷For a comprehensive treatment of the subject, see Aczel 1988.

⁶⁸See, for instance, Teller 1983.

Realism⁶⁹. Overall, none of these options entails that elementary particles are undetermined objects: claiming that they simply lack individuation is just one, and the most radical, of the options available to account for individuality in the quantum world. Furthermore, even that account implies only that certain particles lack determinate diachronic identity across superposition, but not that they completely lack individuality⁷⁰. In any case, the peculiar features of the quantum world do not provide a case for the possibility of undetermined objects.

But at the end of the day, does my account of dependence as individuation do any significant dialectical job here? One might object that, after all, my version of the Argument from Ontological Dependence adds nothing to the version considered by Cameron, since both versions of the argument ultimately rest on the rejection of infinite dependence chains. The difference is that Cameron rejects every kind of infinite dependence chain, whereas I reject only a *certain* kind of infinite dependence chains – namely, those chains that involve the kind of dependence that I have analysed as individuation. Indeed, I have argued that those chains have a problematic aspect – if you want, a *vicious* aspect – that is not obviously shared by every dependence chain. For instance, the dependence a universal entertains with the particulars by which it is instantiated does not seem to be subject to the present worries.

This distinction makes a dialectical difference: arguably, there are some people who are not convinced of the impossibility of *all* infinite dependence chains, but who might be convinced of the impossibility of those infinite dependence chains that involve individuation. Given that at some point we need to rely on some basic assumption, I maintain that the assumption that undetermined objects are impossible is a more solid bedrock than the assumption that infinite dependence chains are in general impossible, which makes my version of the argument more effective dialectically.

With this in mind, my argument against infinite descent can be phrased as follows:

- (1) For any x , if x is a compound object is then x is a mere sum.

- (2) For any mere sum x , if x is determined then x is not gunky.

⁶⁹Or at least the defenders of the weakest version of Ontic Structural Realism, since there is a stronger version claiming that there are no objects at all, but only a relational structure. However, the latter view is subject to the obvious objection that a relation cannot obtain without obtaining between *relata*.

⁷⁰This point is stressed by Lowe (1998: 62-3).

(3) For any x , x is determined.

∴ No compound object is gunky.

The conclusion has some corollaries: first, every compound object is ultimately made up of simples. Second, since every compound object is made up of simples and, so to speak, every simple is trivially made up of itself, every object is ultimately made up of simples. And, needless to say, there are simples. I have defended premise (2) on the ground of an account of dependence in terms of individuation, and I have taken (3) as inherently plausible. (1), which is a statement of Mereological Fundamentalism, has been taken until now as a hypothesis worth considering, to explore its implications. In the remaining part of this paper I will try to assess whether, at the end of the day, there are some further considerations in its favour.

To sum up, the line of reasoning above shows that at least those of us who are inclined to endorse Mereological Fundamentalism can reject gunk without endorsing any contentious version of the Principle of Well-foundedness. Even stronger conclusions follow if one is willing to take the Principle of Individuation as a necessary truth: indeed, the Principle of Individuation is concerned with the most basic relationship between entities, so it looks like a good candidate as a metaphysical law. If this is the case, then every possible world where all compound objects are mere sums is a world where there is no gunk, and where all objects are ultimately made up of simples.

5. Mereological Fundamentalism vs. Priority Monism

In this section, I will contrast Mereological Fundamentalism with an alternative view of fundamentality – namely, Priority Monism, which has been articulated and defended by Jonathan Schaffer (2007, 2010): Priority Monism is the view that all subcosmic objects are grounded by the whole cosmos.

We have already met the concept of factual grounding, but some metaphysicians have also invoked a kind of non-factual grounding, which is supposed to be a relation that obtains between entities that are not facts, such as objects: this is the concept of grounding

that Priority Monism is concerned with⁷¹. The main difficulty when discussing Priority Monism is that the concept of non-factual grounding is taken by Schaffer (2007, 2009b, 2010) as a primitive; as a consequence, the relationship between non-factual grounding and cognate metaphysical relations, like that of ontological dependence, is not that transparent. Nevertheless, there are strong similarities that one can bring out.

First, Schaffer defines a *mere aggregate* as a compound object that is grounded by its proper parts (2009a: 374), which parallels my definition of mere sums in terms of dependence/individuation. Furthermore, all the intuitive examples of non-factual grounding that he offers to explicate the concept seem cases of dependence as well, particularly the kind of dependence that I have analysed in terms of individuation: for instance, the way an entity grounds its singleton or the way a Swiss cheese wheel grounds its holes (Schaffer 2009a: 375)⁷².

I take these analogies as indicators of a significant relationship between the two concepts, and I suggest that, unless some disanalogy is found too, such a connection is best accommodated as coincidence: to simply insist that grounding is not ontological dependence would be to make a distinction without a difference. With this in mind, I propose to define non-factual grounding in terms of individuation, by simply equating it with the kind of ontological dependence that I have defined by the Principle of Dependence. The outcome is the following definition:

Principle of Grounding: For any entities x and y s, x is grounded by y s iff x depends on y s.

(Here, as in the case of dependence and individuation in the Principle of Dependence and the Principle of Individuation, grounding is intended as *complete* grounding: if x is grounded by y_1, \dots, y_n , one can say that y_1 partially grounds x , or that y_1 helps to ground x .) That said, this equation of non-factual grounding with ontological dependence is subject to some objections: in what follows, I will show that none of them is compelling and then I will apply the present definition to the dispute between Priority Monism and Mereological Fundamentalism.

⁷¹Indeed, Schaffer himself has suggested that the distinction between factual grounding and non-factual grounding is negligible, since the former might be reducible to the latter (Schaffer 2012: 123-4). Lacking at the moment any evidence for the possibility of such a reduction, I maintain that the distinction between those two kinds of grounding is still to be taken seriously.

⁷²The other examples made by Schaffer (2009: 375) concern the relation between natural features and moral features and that between a truth-maker and the related truth, but those seem cases of factual grounding.

First, one might object that grounding is not reducible to any kind of ontological dependence because the former is irreflexive, whereas the latter is not. Indeed, I have acknowledged the possibility that an object is individuated by itself, whereas grounding seems to be necessarily irreflexive: it seems impossible that an entity grounds itself⁷³. However, this problem can be accommodated just by a little emendation of the definition above, specifying that an entity is grounded only if it does not depend on itself:

*Principle of Grounding**: For any entities x and ys , x is grounded by ys iff (i) x depends on ys , and (ii) for any entity z , if z is one of ys then $x \neq z$.⁷⁴

Second, one might argue that grounding is not reducible to any kind of ontological dependence because the former is explanatory in a way that the latter is not: for instance, the arrangement of chemicals is explained, at a deeper level, by the arrangement of particles, since “The fact that there are particles arranged in a certain way grounds the fact that there are chemicals arranged in a certain way” (Schaffer 2012: 125). By contrast, the relations of ontological dependence, in particular the one analysable in terms of individuation, does not seem to convey any explanation of this sort.

I grant that those reservations might be founded in the case of factual grounding, which is actually the kind of grounding at work in the example above, but things are different for non-factual grounding. Indeed, an object is not the kind of entity that can be directly taken as an *explanandum*: a question of the form ‘Why a ?’, where ‘ a ’ is a proper name, is ungrammatical. At the most, the existence of an object can be taken as an *explanandum*: indeed, a question of the form ‘Why does a exist?’ is grammatical. To be sure, not every explanation of existence is relevant here: the existence of an object can be at least partially explained by a causal story telling how that object came into being, but that is not the sort of explanation that metaphysicians are concerned with when they talk about grounding. If non-factual grounding has somehow to explain the existence of entities, such an explanation must be concerned with their individuality, i.e. with the question why a given entity is that particular entity, instead of any other one. As one can easily see, this kind of explanation ultimately reduces to that provided by dependence/individuation.

In conclusion, even if one grants that non-factual grounding has some explanatory

⁷³It is worth noticing that even this claim is not entirely uncontroversial: see Jenkins 2011.

⁷⁴On the other hand, one might still equate dependence *tout court* and what Schaffer has called *improper grounding*: “... x improperly grounds $y =_{def} x$ grounds y , or $x=y$ ” (Schaffer 2009: 374).

relevance, that is reducible to that conveyed by individuation. Overall, the reduction to individuation seems to offer an adequate definition of non-factual grounding: such a definition clarifies the concept and provides a criterion for it, without losing any of its explanatory power. Moreover, it allows us to account for the alleged connection between grounding and derivativeness (Schaffer 2009a), since an alternative definition of derivativeness, formulated in terms of grounding, follows from the conjunction of the Principle of Grounding together with the Principle of Derivation:

*Principle of Derivation**: For any entities x and ys , x is derivative from ys iff (i) x is grounded by ys , and (ii) necessarily, if ys exist then x exists.

Unlike Mereological Fundamentalism, Priority Monism is compatible with the existence of gunk, because it does not exclude that there might be an infinite descent toward lower and lower mereological layers, and that every object from every layer depends on the whole cosmos. Schaffer argues that, since the infinite descent is an open possibility, mereological reductionists have a bullet to bite that priority monists easily avoid (2003). But once ontological dependence has been accounted for in terms of individuation, the rejection of gunk is no longer a cost for mereological reductionists: infinite descent is no longer something they have to deny from the start, but something that they can provide reasons against.

So far, the outcome of the confrontation of Priority Monism and Mereological Fundamentalism is a sort of parity verdict, since the *prima facie* possibility of gunk cannot be invoked any longer in favour of Priority Monism over Mereological Fundamentalism. It might seem that, at this stage, the choice between these two alternatives is only a matter of reaching an equilibrium between our intuitions: those who are so convinced of the possibility of gunk that they are "... willing to reject any theory which rules it out" (Sider 1993: 288)⁷⁵, have reasons to prefer priority monism, whereas Mereological Fundamentalism might be better suited for the others.

On closer inspection, the Principle of Grounding* allows us to go even further in the discussion of these options, refuting Priority Monism. Actually, the present account of dependence in terms of individuation seems to rule out the thesis that all subcosmic objects depend on the whole cosmos (Schaffer 2007, 2010a): according to my account of dependence as individuation, Priority Monism amounts to the view that all subcosmic

⁷⁵Later, Sider (2013) has radically changed his view on these issues.

objects are individuated by the whole cosmos. But the Principle of Individuation rules out that two or more distinct entities are individuated by the same entity or entities. Let us suppose that two distinct entities a and b are both individuated by c through an individuating relation R : this entails, among other things, that $R(a, c)$ and $R(b, c)$. But it also entails that $a \neq b$ because $\neg R(a, c)$ or $\neg R(b, c)$. Contradiction! Therefore, two or more distinct entities being individuated by the same entity or entities is incompatible with the Principle of Individuation.

In particular, the Principle of individuation rules out that all subcosmic objects are individuated by the cosmos, so it is incompatible with Priority Monism. One might try to vindicate Priority Monism by endorsing the Bigelow-Ellis-Lierse (1992) view that some laws of nature are due to the essential nature of the whole cosmos⁷⁶. With this in mind, subcosmic objects can be said to depend on the whole cosmos since their nomic behaviour is determined by the nature of the latter. This account of laws is worth considering, but it is not sufficient to establish that subcosmic objects are individuated by the cosmos: since every kind can be multiply instantiated, it is possible that there are cosmoi numerically distinct from this one that, nevertheless, are of the same kind and thus have the same nomic environment. Therefore, it seems that every actual subcosmic object might inhabit any of those cosmoi. To put it in a different way, even if a subcosmic object has to inhabit a cosmos of a certain nature, that does not entail that it has to inhabit one cosmos in particular.

At the most, this strategy might show that subcosmic objects depend on the cosmos in the way an Aristotelian universal depends on the concrete particulars by which it is instantiated: subcosmic objects could not exist without being hosted by a cosmos of a certain kind, as a universal could not exist without being instantiated by some concrete particulars; on the other hand, subcosmic objects could exist even if hosted by another cosmos (of the same kind), as a universal could exist even if exemplified by other concrete particulars. The point is that the kind of dependence at work here is not the one I have defined in terms of individuation: even if the resulting view has some plausibility, every contrast between that view and Mereological Fundamentalism would be an equivocation, since they are concerned with different kinds of dependence. As far as I can see, they might be both true.

⁷⁶Their main case is that of conservation laws, which seem to be concerned with no kind of objects in particular, but with the ontological category of events, determining that all the events occurring in the universe conserve certain physical quantities.

Schaffer famously argues that Priority Monism is empirically supported by modern physics, which says that the universe is an entangled system and that entangled systems have an irreducible unity (2010a). Although these considerations might show that the cosmos is a causally integrated and unified whole, they are not sufficient to conclude that it is prior to subcosmic objects in some metaphysically significant way, least of all in the sense of individuation that I have worked out. In his discussion, Schaffer employs the concept of (non-factual) grounding, taking it as undefined. However, I have shown that non-factual grounding is best analysed in terms of individuation, and that this analysis excludes Priority Monism from the start: if one wants to claim that there is a better way to define non-factual grounding according to which priority monism is defensible, the burden of argument falls on him.

Summary

To sum up, I maintain that either (i) Priority Monism and Mereological Fundamentalism are concerned with different kinds of dependence and therefore are compatible, or (ii) they are concerned with the same kind of dependence and therefore are incompatible. In the latter case, Mereological Fundamentalism is more plausible than Priority Monism, since, if understood in terms of individuation, Priority Monism is ruled out by the conjunction of the Principle of Grounding* and the Principle of Dependence.

That being said, I want to end the present inquiry stressing that the rejection of Priority Monism is not sufficient to establish that Mereological Fundamentalism is the true view about the priority structure of the world, since there are still some alternative options. For instance, one might endorse the broadly Aristotelian view that among compound objects, those that have the appropriate kind of integration are substances, living things being the most obvious candidates⁷⁷: with this in mind, one might argue that compound substances individuate at least some of their proper parts⁷⁸. The second claim can be specified in various ways: for instance, one might argue that only the functional parts of a multicellular

⁷⁷This claim is not to be confused with Van Inwagen's (1990) stronger claim that there are no compound objects at all except for living things.

⁷⁸According to the interpretation defended by Marmodoro (2013), Aristotle himself endorsed a view along these lines, as shown particularly by what she calls *Homonymy Principle*, according to which at least some proper parts of a substance "... cannot even exist if severed from the whole; for it is not a finger in *any* state that is a finger of a living thing, but the dead finger is a finger only homonymously" (Aristotle 1984: 1634; *Meta*.1035b24-25).

organism – namely, its organs – are individuated by the whole organism, whereas the subatomic particles that compose it are not. At the end of the spectrum of these broadly Aristotelian options, we find the radical view that all the proper parts of a compound substance are individuated by that substance⁷⁹. Finally, another option alternative to both Mereological Fundamentalism and Aristotelian anti-reductionism is provided by what I have already called *Mereological Horizontalism*: this can be now rephrased as the view that compound objects are not individuated by their proper parts, but they are not prior to them either. According to this view, all compound and simple objects lie on the same ontological level.

In chapter 5, I have argued against the existence of compound substances, which *ipso facto* rules out the Aristotelian views above. In this chapter, I have argued against Priority Monism. Even if one is convinced by my cases against Priority Monism and the Aristotelian views, the defenders of Mereological Fundamentalism still have to rest on the intuition that parts are prior to the whole that they compose, since there is at least one alternative view of priority that has not been refuted yet – namely, Mereological Horizontalism. This is still a live option because, after all, it is not obvious that some objects are prior to others: perhaps parts and wholes are on a par. To defend Mereological Fundamentalism by something more than a brute intuition, one would need additional arguments that I have not offered here. Nonetheless, I have shown that at least those who are inclined to accept Mereological Fundamentalism also have reason to maintain that there is no gunk or infinite descent and that all objects are ultimately made up of simples.

⁷⁹Such a radical view has been actually defended by Oderberg: "... in the existing substance the quarks have no substantial identity on their own, their behavior having been fully yoked to the function and operations of the substance in which they exist. ... the quark is ontologically dependent on the whole of which it is part..." (2007: 71).

Chapter 7. Existence Monism and the Possibility of Heterogeneous Simples

Introduction

In chapter 6, I outlined an argument for the existence of mereological simples, showing that at least those who are willing to accept Mereological Reductionism have reasons to maintain that all objects are ultimately made up of simples. Nevertheless, I have not endorsed any commitment about the nature of those simples. To put it otherwise, I have not tried to assess which natural kinds simples belong to: are mereological simples human beings, chair, electrons or whatever? One might think that this is not a very interesting question for philosophers: first, it seems obvious that to take human beings or chairs as simples is a non-starter, because those are obviously compound objects. Instead, the only plausible candidates as mereological simples seem to be certain microscopic objects studied by subatomic physics: maybe elementary particles, maybe strings, or maybe something else still to be discovered. With this in mind, one might conclude that there is no work left for philosophers here and that to assess which objects are simples is only a job for physicists.

Like many widespread views, this view of the nature of mereological simples has been also questioned by metaphysicians. In particular, it has been questioned in the ongoing debate on monism: Existence Monism is, in its most common formulation, the view that there is exactly one object – namely, the cosmos⁸⁰. Existence Monism entails that the cosmos is simple, because if it had proper parts there would be *ipso facto* objects other than the cosmos itself. One might think that such a view is obviously false, because there is so much stuff going on in the cosmos that one cannot believe that it has no proper parts. Indeed, all the sides of the debate grant that the cosmos exhibits diversity across space: if this is not plausible enough to be taken for granted, nothing is. This point is acknowledged also by defenders of Existence Monism: for instance, Horgan and Potrč grant that the

⁸⁰See Schaffer (2007a, 2007b) for the distinction between Existence Monism and Priority Monism.

whole universe has an “enormous local variability” (2000: 249).

With this in mind, one can question the inference from the cosmos being qualitatively complex to it being mereologically complex too. The tenability of Existence Monism is related to the more general “problem of qualitative heterogeneity” (McDaniel 2009: 326), which is the question whether and how an object with no proper parts can host qualitative variations across the spatial region it occupies⁸¹: Existence Monism is true only if the problem of qualitative heterogeneity has a positive answer. In this chapter, I will argue that the answer to the problem of qualitative heterogeneity is negative: qualitatively heterogeneous simples are impossible, so Existence Monism is false.

First, a clarification of the commitment of Existence Monism is needed: what is the cosmos? Intuitively (and roughly), the cosmos is this whole comprehensive thing that includes us. One might be tempted to define the cosmos as that object such that, for every object x , x is part of it (Schaffer 2010a: 33). At a closer look, this definition is unsatisfactory, because it implies that there is at the most one cosmos, whereas the existence of many distinct cosmoi seems at least conceivable: with this in mind, an adequate definition of “cosmos” should not rule out that possibility. As I have already done elsewhere (Benocci 2017), I propose to define a cosmos as a causally isolated object, by which I mean an object that cannot interact with any object mereologically disjoint from it. It is metaphysically possible that there are many objects causally isolated from each other, so my definition has the virtue of not excluding the possibility of many cosmoi⁸². Indeed, as far as we know, there might be cosmoi other than the one that we inhabit: the existence of a plurality of cosmoi is an open, though not empirically assessable, epistemic possibility that we should stay agnostic about⁸³. In what follows I will use the phrase “this cosmos” or simply “the cosmos” to denote the cosmos that we inhabit.

Once one has acknowledged the – metaphysical and epistemic – possibility of a

⁸¹ Those who endorse the possibility of qualitatively heterogeneous simples must accept the possibility of spatially extended simples: an object that occupies a point-like spatial region cannot host qualitative variations across space because its location is not large enough. The metaphysical possibility of extended simples is widely considered to be worth taking seriously among metaphysicians (Markosian 1998; Parsons 2004; Simons 2004; McDaniel 2007a, 2007b; Sider 2007a), so here I am going to grant such a possibility at least for the sake of argument.

⁸² Lewis (1986a) famously defined possible worlds in terms of causal and spatiotemporal isolation, but cosmoi are not the same as possible worlds: by “possible world” it is meant, roughly, a complete possible state of reality, whereas cosmoi are among the objects that exist at possible worlds. With this in mind, my claim that there might be many cosmoi so defined is incompatible with modal realism: according to modal realism, an isolated object is *ipso facto* a possible world on its own, so no possible world contains many isolated objects. Whether the definition of “cosmos” that I am adopting could be combined with some revised version of modal realism is an issue I will not discuss here.

⁸³ It is not empirically assessable because observations require some appropriate causal connection, whereas according to my definition another cosmos would be causally disconnected from the cosmos that we inhabit.

plurality of cosmoi, Existence Monism cannot be stated anymore as the claim that this cosmos is the only object. Nevertheless, its spirit can still be vindicated, since what existence monists are really concerned with is this cosmos not hosting any subcosmic object. Therefore, Existence Monism can be reformulated directly as the view that this cosmos is mereologically simple⁸⁴. Likewise, I will name *Pluralism* the view that this cosmos is not mereologically simple.

Second, by “quality” I mean a property that is both intrinsic and pure. Intuitively, an intrinsic property is a property that an object has only because of the way that very object is, whereas “the extrinsic properties of something may depend, wholly or partly, on something else” (Lewis 1983: 197). Though hard to define, the concept of intrinsicness is clear enough to work with. An impure property is a property that consists in a relation with certain objects, like *being the first wife of Napoleon* or *being taller than Michael Jordan*. A property is pure if and only if it is not impure. Not all intrinsic properties are pure: *having Jupiter as part* is intrinsic and impure. Qualities are (all and only) those properties that are both intrinsic and pure: relatively uncontroversial examples of qualities are *being round*, *being red*, and *having a mass of 3 kg*⁸⁵.

With these qualifications in mind, I take as a phenomenological datum that qualitative heterogeneity at least *seems* to require mereological complexity. Consider an object *a* that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) and is *F* at r_1 and *G* at r_2 (where *F*-ness and *G*-ness are two mutually incompatible qualities): it seems that *a* has a proper part located at r_1 that is *F* and another proper part located at r_2 that is *G*. Those who deny the possibility of qualitatively heterogeneous simples just take that seeming at face value, whereas those who embrace that possibility do not. In order to make their claim defensible, the latter have to save appearances by building a “sufficient alternative explanation” (Cornell 2016: 2401) suited to account for that appearance of mereological complexity. To put it in a different way, they have to explain how an object can be qualitatively heterogeneous without having proper parts, as set out by McDaniel (2009: 326).

Likewise, this cosmos hosts striking qualitative variations, and seems to be made up by a vast plurality of subcosmic objects: again, pluralists just take that seeming at face value. On the other hand, existence monists have the burden of explaining how that appearance

⁸⁴ One might even consider the stronger view that, necessarily, every cosmos is simple. In this work, I will not be directly concerned with this view. However, my arguments against Existence Monism will target *ipso facto* this stronger view as well.

⁸⁵ This is the definition of “quality” adopted, among the others, by Hawley (2009: 102) and Orilia and Swoyer (2016).

can be compatible with the cosmos actually being a giant simple. In this vein, Sider (2007b) suggests that pluralists have an initial advantage over existence monists, since they can account for the range of possible states of the cosmos just by appealing to the possible states and arrangements of subcosmic objects. That strategy is not available to existence monists, who have to offer an alternative account (2007b: 3): to build such an account is to answer the problem of qualitative heterogeneity, proposing what Cornell calls “sufficient alternative explanation” (2016: 2401).

In what follows, I will argue that such an explanation is not available, so qualitatively heterogeneous simples are impossible⁸⁶ and Existence Monism is false. My main argument can be put in the following deductive form:

- (1) If qualitatively heterogeneous simples are possible, then there is an explanation of how they are possible.
 - (2) There is no explanation of how qualitatively heterogeneous simples are possible.
- ∴ Qualitatively heterogeneous simples are not possible.

In this section, I have defended premise (1). In the next sections, I will defend premise (2). As one can easily guess, I will proceed by elimination, examining the candidates as sufficient alternative explanation, namely (i) the irreducible, non-uniform distributional properties view defended by Parsons (2004) and Cornell (2016), (ii) the localized tropes view defended by McDaniel (2009), (iii) the object-stuff dualism defended by Markosian (1998, 2004), (iv) the view that (at least some) qualities are relations with spatial regions, and (v) adverbialism (Schaffer 2010a). I will show that all of these strategies fail. Since there are no other options available, one should conclude that qualitatively heterogeneous simples are impossible.

Finally, I will show that this conclusion provides us with a negative indicator of mereological simplicity that vindicates our common intuitions about which objects are simple and which are not and gives us an “aid in our quest to discover the true atoms of the world” (McDaniel 2007a: 261).

⁸⁶An argument against the possibility of heterogeneous simples has been also built by Spencer (2010). Regrettably, that argument assumes the possibility of extended atomic regions of space, which has been later questioned by Spencer himself (2014).

1. Non-Uniform Distributional Properties

Parsons (2004) has defended the possibility of heterogeneous simples by invoking the concept of a distributional property, namely “a way of painting, or filling in, a spatially extended object with some property” (2004: 173). A distributional property can be either uniform or non-uniform: *being red all over* is a uniform distributional property, whereas *being polka-dotted red on white* is non-uniform. Parsons argues that at least some distributional properties are not reducible to logical constructions out of local non-distributional properties⁸⁷.

With this in mind, one might maintain that a simple object can be qualitatively heterogeneous just by instantiating an irreducible, non-uniform distributional property: for example, a simple *a* can instantiate the property *being half-F-and-half-G* without having two proper parts of which one instantiates *F*-ness and the other instantiates *G*-ness. In particular, existence monists could claim that the possible states of the cosmos just are the distributional properties it can possibly instantiate.

The problem with this view is that, as McDaniel observes, it “... cannot provide a finite analysis of propositions of the form ... ‘*x* is *F* at region *r*’ ...” (2009: 329): instantiating a distributional property like *being half-F-and-half-G* is not sufficient to be *F* or *G* at any given region, because two objects can be both half-*F*-and-half-*G* even though they are located at different regions. This undermines the present proposal as an account of qualitative heterogeneity. Let us consider a simple *a* that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) and is *F* at r_1 and *G* at r_2 : the present framework allows us to say only that *a* as a whole instantiates the property *being half-F-and-half-G*, but it does not explain why *a* seems to have a proper part located at r_1 that is *F* and another proper part located at r_2 that is *G*. As a result, Parsons’s proposal does not offer a sufficient alternative explanation of qualitative heterogeneity and the appearance of mereological complexity.

Cornell (2016) tries to improve Parsons’s proposal by resorting to the concepts of distributable property and distribution pattern⁸⁸: distributable properties are the qualities distributed by distributional properties, whereas distribution patterns are the specific ways

⁸⁷For instance, a property like *being polka-dotted red on white* seems to be analysable as *being an x such that there are some ys , and ys are part of x , and ys are of the right sort of colours, and the ys are spatially related in the right sorts of ways*. Parsons (2004) argues that this kind of reduction fails.

⁸⁸The concept of a distributable property is introduced by Parsons (2004).

those qualities are distributed across extended objects. Whenever an object instantiates a non-uniform distributional property, there are some distributable properties that are distributed across it according to a certain pattern. For instance, in the case of an object that instantiates *being polka-dotted red on white*, the distributable properties are redness and whiteness, which are distributed polka-dot-ly across the object. At first glance, the appearance of mereological complexity seems easy to account for within this framework: a simple a that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) and is F at r_1 and G at r_2 seems to have a proper part that is F and a proper part that is G because F -ness is distributed at r_1 and G -ness is distributed at r_2 , and those sub-regions correspond to the locations of the alleged proper parts of a .

But in what sense can a distributable property be *distributed* across a simple? The most obvious way in which a quality can be distributed at a region r is by being instantiated at r , but this kind of analysis is not available when one deals with simples. Let us consider a simple a , which instantiates *being half- F -and-half- G* and occupies a region r : is there any sense in which F -ness is distributed at some sub-regions of r ? By hypothesis a does not instantiate F -ness, but rather a more structured, non-uniform distributional property. On the other hand, a has no proper part instantiating F -ness because it has no proper parts at all. It seems that there is no object that is suitably related to a and instantiates F -ness⁸⁹. Therefore, there is no intuitive sense in which F -ness is distributed across a : every appeal to distributable properties seems just misplaced.

Cornell seems to overlook the point above, since he claims that “the monist can explain ... appearances by saying that the world instantiates certain properties (i. e. *table-ness*, *chair-ness*, *cat-hood*, etc.) distributed in patterns that correspond with the locations of the alleged entities in question” (2016: 2408-9). Such a view is obviously false: the world instantiating cat-hood entails that the world is a cat! In general, the qualities that are commonly supposed to be instantiated by subcosmic objects cannot be instantiated in any way by the whole cosmos⁹⁰, and the same applies to any simple object.

One might try to regiment Cornell’s account by invoking a primitive two-place relation *being present at* that distributable properties entertain with spatial regions: F -ness being

⁸⁹ If it is possible that mereologically disjoint objects occupy overlapping spatial regions, then it is possible that there is an object that is F and occupies a sub-region of r but is not part of a . However, that object being F would have no relevance to F -ness being distributed across a , at least not in a way that can make a qualitatively heterogeneous.

⁹⁰ Although he takes as examples properties such as table-ness and cat-hood, Cornell observes that a monist description of the cosmos is likely to invoke more fundamental distributable properties, such as the fundamental masses and charges that according to pluralists are instantiated by elementary particles. My point applies to those properties as well.

present at r is an irreducibly relational fact, which does not depend on F -ness being instantiated by an object, and which indeed can obtain even if there is no object exactly located at r that is F . A distributable property F -ness being distributed across a simple object a (according to some distribution pattern) just consists in F -ness being present at some sub-regions of the region exactly occupied by a . In the case of a simple that occupies r and is polka-dotted red on white, redness and whiteness are distributed across it just because they are present at some sub-regions of r .

Such a regimentation of Cornell's view is consistent, but it is still subject to the worry that we have seen above: how can a quality be in any way "present" at a region r , if there is no object that instantiates that quality at r ? It seems to me that the conceptual confusion underlying Cornell's proposal is to assume that qualities can be somehow divided into partitions and that those partitions can be freely spread across space as if they were bits of stuff, so that we can have a bit of redness here, another bit there, and so on. As Levinson stresses, "it is very hard to believe that there is such a thing like abstract stuff – that is something that is stuff, and yet abstract – of which there might be bits" (2006: 567). If Cornell's proposal is committed to something along those lines, then it is in a bad shape.

In conclusion, to admit the possibility of irreducible, non-uniform distributional properties does not help to explain how a simple object can be qualitatively heterogeneous, and Cornell's appeal to distributable properties and distribution patterns does not make things better.

2. Localized Tropes

Another explanation of how a simple can be qualitative heterogeneous has been proposed by McDaniel (2009). McDaniel's idea is that an object can bear non-resembling localized tropes, i.e. localized instances of qualities. Take a ball that is half red and half yellow: it seems reasonable to maintain that it bears a trope of redness at one half and a trope of yellowness at the other half. Now consider a simple a that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) and bears a trope of F -ness and a trope of G -ness, the first one being located at r_1 and the second one at r_2 : such an object would exhibit qualitative variations across the region it occupies even though it does not have proper parts. The appearance of mereological complexity is explained by the fact that the simple a bears localized tropes of F -ness and G -ness whose locations correspond to those of its alleged proper parts.

The application of this account to Existence Monism delivers a picture that reminds one of Spinoza's metaphysics: the cosmos is a simple that bears a multitude of *modes*, which are particular properties of the cosmos⁹¹, and some of those modes are localized⁹². According to this view, there is nothing wrong with common sense or with scientific discourse: the problem is with the mainstream metaphysical view according to which subcosmic particulars are objects that are part of the cosmos, whereas they are localized modes of the cosmos. Once one has acknowledged this point, one can keep on talking about human beings, plants, and subatomic particles in a literal way, without any paraphrase or other semantic tricks⁹³: every incredulous stare inspired by common sense is eluded from the start.

Instances of properties like redness can be accommodated by taking their instances as higher-order modes, or hypermodes: the cosmos bears localized modes like human beings, trees and electrons, and those first-order modes bear second-order modes like instances of redness. This move would be by no means strained or artificial, since some trope theorists actually maintain that, for example, a trope of redness could bear a hypertrope of a certain degree of brightness (Bacon 1995). An existence monist would just need to add that the first step of this ladder is provided not by so-called ordinary objects – which actually are not objects at all – but by the whole cosmos. The possible distributions of modes (McDaniel 2009: 330-31), together with that of their possible hypermodes, accounts for the range of possible states of the cosmos.

The present theory seems to be a pretty promising version of Existence Monism. As we have seen, it relies on McDaniel's account of heterogeneous simples in terms of localized tropes: is this account tenable? I am going to show that it is not, because the possibility of localized tropes is inconsistent with certain basic principles about tropes.

First, one must reflect on the relationship between the location of a trope and the location of the object it belongs to. Consider a trope that belongs to a certain object: where is that trope located? The most intuitive answer is offered by a principle that is implicitly

⁹¹An interpretation of Spinoza's metaphysics along these lines was already endorsed by Bayle in his criticism of *Ethics* (Bayle 1709/1991) and is still supported by contemporary Spinoza scholars like Bennett (1984, 1991) and Carrero (1995). On the contrary, Curley (1969, 1991) ascribes to Spinoza the more innocuous claim that subcosmic entities are objects, and that their dependence on the one substance is just a matter of causal dependence: according to this reading, Spinoza's metaphysics is, at the most, a version of priority monism – namely, the view that all subcosmic objects depend on the whole cosmos.

⁹²I say just "some" because one could maintain that the cosmos as a whole instantiates certain natural properties too, as argued by Bigelow, Ellis, and Lierse (1992): within a Spinozian monism, such features would be accommodated as global modes, i.e. tropes that belong to the cosmos and are exactly co-located with the cosmos itself.

⁹³See, for instance, the "indirect correspondence" invoked by Horgan and Potrč (2000, 2012).

assumed in the literature on tropes:

Principle of Exact Co-Location: Necessarily, for every trope f , every object x and every region r , if f belongs to x and x exactly occupies r , then f exactly occupies r .

Some qualification about the concept of *belonging* at work here is needed: when I say that a trope f belongs to an object a , I mean simply that f is a trope of a , or that f characterizes a . Likewise, I take *bearing* as the inverse relation of *belonging*: an object a bears a trope f if and only if f belongs to a . With this in mind, I am not making any assumption about the priority/dependence hierarchy between tropes and objects: this concept of belonging applies to both those theories according to which tropes depend on irreducible substrata (Lowe 1998, 2006) and those bundle theories according to which tropes are fundamental and objects are mere sums of tropes (Campbell 1990)⁹⁴.

With the qualifications above in mind, the Principle of Exact Co-Location is intuitively appealing: where could a particular property of the object a be located if not exactly where a is located? That said, McDaniel's strategy explicitly rejects this principle: indeed, his strategy admits the possibility of tropes that exactly occupy a proper sub-region of the region exactly occupied by the object that they belong to. I concede that this move has some intuitive appeal too: if we consider again the example of the ball having a red half and a yellow half, it seems plausible to say that there is a trope of redness *here* and a trope of yellowness *there*, and that those tropes belong to the ball. If this is the case, then the Principle of Exact Co-Location is false, and localized tropes are possible. Therefore, it seems reasonable to grant that they can belong to simples too, so a simple can be qualitatively heterogeneous by bearing localized tropes.

On closer inspection, the alleged counter-example of the ball fails, because it is inconsistent with the following principle:

Principle of Predication: Necessarily, for every object x and any property F -ness, there is a trope of F -ness that belongs to x only if x is F .

⁹⁴ One might argue that the bundle theory is a non-starter when it comes to discussing Existence Monism: if the cosmos is a sum of tropes, then it has *ipso facto* those tropes as proper parts. I contend that such an objection would not be substantive, because one can claim that the cosmos is a sum of tropes and at the same time retain the spirit of Existence Monism by maintaining that the cosmos has no material proper parts, so it hosts no subcosmic objects.

The Principle of Predication has a great intuitive appeal, so it looks like a reasonable assumption: a trope is a particular property, the property of being in a certain way, and it can characterize an object only if that object is that way. In the case above, no trope of redness belongs to the ball, because, strictly speaking, the ball is not red! The Principle of Predication entails that, at the most, the whole ball can bear a trope of a property like *being half-red-and-half-yellow*, which actually is, in Parsons's terms (2004), a non-uniform distributional property. The tropes of redness and yellowness can belong only to certain proper parts of the ball, namely its red half and its yellow half.

Now consider a simple that is half *F* and half *G*: can such an object bear localized tropes of *F*-ness and *G*-ness? The line of reasoning seen above applies here as well: the simple is neither *F* nor *G*, so it bears neither tropes of *F*-ness nor tropes of *G*-ness. At the most, it can be said to bear a trope of *being half-F-and-half-G*, which is, again, a non-uniform distributional property. Therefore, cases with this structure do not qualify as counter-examples to the Principle of Exact Co-Location. It seems that the most one could say about such an object is that it bears a trope of a non-uniform distributional property. As we have seen in section 2, that is not sufficient to account for qualitative heterogeneity.

Friends of localized tropes might be tempted to elude this objection by rejecting the Principle of Predication for an alternative principle:

*Principle of Predication**: Necessarily, for every region *r*, every object *x* located at *r* and any property *F*-ness, there is a trope of *F*-ness that belongs to *x* only if either (i) *x* is *F* or (ii) there is a region *r'* such that *r'* is a sub-region of *r* and *x* is *F* at *r'*.

Applying this principle to simples does not help the friends of localized tropes: the principle just assumes that a simple can be *F* at a sub-region of the region that it exactly occupies without explaining how that is possible. To reject the Principle of Predication for the Principle of Predication* enables one to defend the existence of localized tropes, but not to solve the problem of qualitative heterogeneity.

Let us take stock. We have seen that the alleged counter-examples to the Principle of Exact Co-Location fail because they are inconsistent with the Principle of Predication, that the defenders of localized tropes cannot reject without abandoning the localized tropes strategy. Given that the Principle of Exact Co-Location is intuitively plausible and that the apparent counter-examples fail, we have good reasons to accept it.

With this in mind, we can employ the Principle of Exact Co-Location to build an

argument against the possibility of localized tropes. But first we need to define the phrase ‘localized trope’:

f is a localized trope =_{def} (f is a trope and) there is some object x and two regions r and r' such that f belongs to x , x exactly occupies r , f exactly occupies r' and r' is a proper sub-region of r .

Given this definition, we can reduce to absurdity the possibility of localized tropes. Let us suppose that there is a localized trope f , i. e. that there is a trope f , an object x and two spatial regions r and r' , such that x occupies r , f occupies r' , r' is a proper sub-region of r , and f belongs to x . It follows that f is not exactly co-located with the object that it belongs to, which contradicts the Principle of Exact Co-Location. Therefore, it is impossible that there are localized tropes.

Indeed, in any scenario where an object x occupies a region r and a trope f occupies r' (with r being a proper sub-region of r), either (i) f does not belong to any object⁹⁵, or (ii) there is another object y that occupies r' , such that f belongs to y . In either case, f is not a localized trope of x . In conclusion, localized tropes are impossible and thus, *a fortiori*, it is not possible that a simple object bears localized tropes.

Despite the line of reasoning above, one might insist that localized tropes are possible just by appealing to the brute intuition that they are possible. However, this move would be dialectically pointless, since here such an intuition is likely to be shared only by those who are already convinced of the possibility of qualitatively heterogeneous simples. In conclusion, McDaniel’s doctrine of localized tropes does not help to build an explanation of the possibility of qualitatively heterogeneous simples.

3. Object-Stuff Dualism

A different strategy can be worked out by endorsing Markosian’s distinction between objects and stuff (1998, 2004): human beings, chairs and electrons are objects, while water and gold are stuff. The composition of an object is twofold: an object like Socrates is

⁹⁵ Odd as it might seem, the possibility of free-floating tropes (i.e. tropes that do not belong to any object) has been actually embraced by Campbell (1990: 59), whereas others have dismissed it (Lowe 1998: 207). For the purposes of the present chapter, I can stay agnostic about this issue.

composed of both parts, like his heart or his arms, which are objects too, and portions of certain kinds of stuff, like blood or water. Those portions are not parts of Socrates and, nevertheless, are related to him by a non-mereological, irreducible kind of constitution.

How should we individuate the portions of stuff that constitute an object? The most reasonable criterion seems to be offered by the following principle:

Principle of Arbitrary Undetached Portions: For any object x and any region r such that x exactly occupies r , for every sub-region r' of r there is exactly one portion of stuff that exactly occupies r' and constitutes x .⁹⁶

This principle allows us, so to speak, to arbitrarily cut an extended object into portions of stuff. An extended simple has no proper parts and, nonetheless, according to the Principle of Arbitrary Undetached Portions, it is made up of many portions of stuff, maybe portions of an undetermined primary stuff that does not belong to any kind.

With this in mind, the problem of qualitative heterogeneity can be answered by assuming that a simple object can exhibit qualitative variations across space in a derivative way, as long as disjoint portions of its stuff instantiate different qualities. For example, a simple a that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) can be F at r_1 and G at r_2 in a derivative way, provided that its portion of stuff that exactly occupies r_1 instantiates F -ness and the one that exactly occupies r_2 instantiates G -ness. The appearance of mereological complexity is explained by the fact that the simple is actually made up of many portions of stuff with different qualities, even if those portions are not proper parts of the object.

McDaniel considers this option, but he rejects it as a non-starter, observing that a quality which is not instantiated ultimately by an object would be “free-floating” (2003: 274). Actually, I do not see why a quality could not be ultimately instantiated by an entity that is not an object: for example, it is not obviously false that events can have qualities. Moreover, the present view seems to have illustrious antecedents: in Aristotle’s physics, the elementary qualities (hot, cold, moist and dry) are supposed to be instantiated by portions of stuff, not by primary substances or other thing-like entities (Aristotle (1984): *On Generation and Corruption*). I will argue that the problem with this approach lies

⁹⁶ This principle is close to McDaniel’s *Doctrine of Arbitrary Undetached Portions* (2003: 272). It is worth noticing that Markosian (2004) has endorsed a *Doctrine of Wholly Arbitrary Portions*, which is different from the present principle.

elsewhere: even if one grants that there is some motivation for the distinction between objects and portions of stuff, allowing for qualitative variations across the amount of stuff constituting a simple object would lead to a collapse of that distinction.

As we have seen, according to this view local qualities are primarily instantiated by the portions of stuff that constitute an object, so the object itself can be said to be *F here* or *there* only in a derivative way. But consider those cases where an object *a* is *F* as a whole: should we conclude that even in those cases *F* is primarily instantiated by a certain portion of stuff, namely the entire amount of stuff constituting *a*? One might assume that at least some qualities are directly instantiated by objects, without the mediation of the stuff that constitutes them, but such a distinction seems arbitrary: why should the features of an object depend on the features of its stuff for some qualities but not for others? Every brute distinction between qualities primarily instantiated by portions of stuff and qualities directly instantiated by objects would be artificial.

Alternatively, one might accept that *all* qualities are ultimately borne by portions of stuff: given any object *a* that is *F* as a whole, *F*-ness is primarily instantiated by the entire amount of stuff constituting *a*. But if one makes this move, object-stuff dualism becomes pointless: objects as distinct from portions of stuff become theoretically redundant, because they do not play any role as property-bearers anymore. It would be simpler to maintain that objects are nothing but portions of stuff and the proper parts of an object are (all and only) the sub-portions of stuff which constitute it. Unfortunately, the conjunction of this stuff-theoretic mereological analysis with the Principle of Arbitrary Undetached Portions entails that every simple object is *ipso facto* constituted by exactly one bit of stuff: therefore, its amount of stuff is not rich enough to host qualitative variations.

To summarise, the present strategy either is committed to an *ad hoc* assumption, or it ends up collapsing object-stuff dualism, implying that a simple object is constituted by exactly one bit of stuff and thus cannot host qualitative variations. In either case, even Markosian's object-stuff dualism does not offer a satisfactory account of the possibility of qualitatively heterogeneous simples.

4. Quality-Relations

Another option available to friends of heterogeneous simples is to embrace a deeply revisionary view of qualities, admitting the possibility of qualities that are not intrinsic

properties, but rather relations with spatial regions. Give this assumption, one could maintain that a simple that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) can entertain the relation F with r_1 and the relation G with r_2 .

According to the present view, a heterogeneous simple's being F at a sub-region of its location amounts to an irreducibly relational fact, which cannot be analysed by singling out localized tropes of F -ness or portions of stuff that instantiate F -ness. A version of Existence Monism based on this approach would describe the cosmos as a giant simple that entertains the electron-relation with *this* place, the human-relation with *that* place, and so on. A simple that entertains different quality-relations with different sub-regions of the place it occupies seems to be mereologically complex because the allocation of those relations maps the locations of its alleged proper parts: for example, a simple cosmos entertains the electron-relation with (and only with) the places where electrons are supposed to be located.

McDaniel dismisses this view as a non-starter because "there is no such thing as a colour-relation between a thing and a place" (2003: 274), and every sentence of the form ' a is F at r ' must be analysable as a sentence talking about parts. As it stands, this reservation is far from conclusive. Actually, we usually talk about objects being red *here* and yellow *there*: the doctrine of quality-relations might just be a straightforward way to analyse this kind of discourse.

That said, I think that the spirit of McDaniel's point can be vindicated. The intuitive worry with the present view is that it does not do justice to the sort of features qualities are: it seems that qualities are different from the positional relations that objects entertain with spatial regions, like *being located at* or *being to the left of*. The standard view of qualities offers a natural account of this intuitive difference because it maintains that qualities are intrinsic properties, not relations. On the contrary, friends of quality-relations are unable to capture this difference: according to their view, both of those kinds of features are relations that obtain between objects and spatial regions.

In conclusion, there is an obvious difference in the world that the standard view of qualities easily accounts for, whereas the quality-relations does not. Of course, the defenders of the latter might even grant that there is a fundamental distinction between quality-relations and positional relations, but within their picture that would be a distinction without a difference. It seems that even the theory of quality-relations does not offer a satisfactory explanation of the possibility of heterogeneous simples, because it neglects evident differences in reality.

5. Adverbialism

Schaffer (2010a) suggests that we resort to a “regionalized instantiation” to be expressed by adverbialized predicates: it is possible that an extended simple that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) is- r_1 ly F and is- r_2 ly G (2010: 60). On its own, embedding a reference to a spatial region into the copula of predication is just a notational device: to motivate it one also needs to account for the features picked up by those adverbial phrases. In the absence of such an account, one might wonder whether there is any substantive difference between this approach and the quality-relations view.

Schaffer’s proposal is to ground this adverbialized predication on a three-place relation of instantiation obtaining between an object, a quality and a spatial region: a proposition of the form $\langle a \text{ is-}r\text{ly } F \rangle$ states that such an instantiation obtains between a , F -ness and r . The problem is that the very same template might be applied to the quality-relations account as well: an object, a quality, and a spatial region stand in a three-place relation, which can be viewed as a kind of instantiation. One could reply that the relation is not the same because here the region occupies a different argument-role but, again, lacking an informative analysis this would be a distinction without a difference.

To summarise, adverbialism either collapses into the quality-relations view – in which case it is subject to the difficulties that we have seen in section 5 – or is committed to an unexplained distinction between argument-roles.

Summary

It seems that there is no way to explain how an object can host qualitative variations without having proper parts, and this consideration applies *a fortiori* to that peculiarly varied object that is the cosmos. Needless to say, this conclusion makes no difference for those who think that the possibility of qualitatively heterogeneous simples is not problematic at all: they will be happy to accept that possibility without asking for an explanation. Something similar holds for those who ask for an explanation but think that such an explanation is trivial: a simple a that occupies r_1+r_2 (where r_1 and r_2 are disjoint spatial regions) can be heterogeneous just by being F at r_1 and G at r_2 (where F -ness and G -ness are two mutually incompatible qualities), and that’s all. According to this

deflationary view, a simple object having a certain quality locally is a brute fact, which does not require any special account of instantiation or predication.

That being said, my argument by elimination should be worth at least for those who grant that the possibility of heterogeneous simples is problematic and that its defenders have to offer what Cornell calls a “sufficient alternative explanation” (2016: 2401). Of course, there might be some further alternatives available to them that I have not considered here: if somebody manages to put a new proposal on the table, the case can be reopened. In the meanwhile, those who think that there is a problem of qualitative heterogeneity have good reasons to reject the possibility of qualitatively heterogeneous simples and thus to reject Existence Monism too.

It is worth stressing that, while that there are no heterogeneous simples is, if true at all, an *a priori*, necessary truth, a pluralistic conclusion about the mereological structure of this cosmos does not obtain for every possible cosmos. I maintain that a simple cosmos is metaphysically possible and maybe there are cosmoi distinct from this one that are simple, but those would be, so to speak, pretty flat and boring cosmoi with no diversity at all, like a one-particle cosmos. Nonetheless, we have empirical evidence that our cosmos has a vastly different nature and the impossibility of heterogeneous simples implies that a simple cosmos qualitatively similar to this one is impossible.

These conclusions also provide us with a negative indicator of mereological simplicity. If there was no informative necessary condition for mereological simplicity, then we would be threatened by the prospect of a sort of mereological scepticism: we would have a plethora of alternative, mutually exclusive hypotheses about what the denizens of the world are, and which of them are simple or not, without having any criterion to filter them. Elementary particles, human beings, trees, or the whole cosmos would be equally eligible as simple objects: the common belief that the only simples are certain microscopic objects, revisionary metaphysical views like Existence Monism, or the arbitrary claim that chairs and rocks are simple would all have the same plausibility.

The doubt that there might be no criterion to filter those hypotheses is reinforced by McDaniel’s *Brutal View of Simples* (2007a) – namely, the claim there is no set of informative (i.e. non-enumerative), non-mereological, necessary and sufficient conditions for being a simple. I will not discuss McDaniel’s arguments here since I find them convincing. However, even if the Brutal View is true, as I am inclined to think, that does not entail that there is no indicator on which we can rely to assess whether an object is simple or not. As McDaniel himself notices (2007a: 260-1), there is no need for a proper

definition to have some criterion: some informative, necessary but not sufficient conditions would be enough to rule out the oddest hypotheses about which objects are simple.

Nonetheless, McDaniel gives us no such criteria.

The present inquiry provides us with an informative, necessary condition for an object being simple, which enables us to escape from mereological scepticism: if an object is qualitatively heterogeneous, then it is not a simple. I do not see any argument for the claim that being qualitatively homogeneous is also a sufficient condition for being a simple, so I am still inclined to think that the Brutal View of Simples (McDaniel 2007a) is true.

Nevertheless, we have a negative indicator that enables us to vindicate our pre-theoretical intuitions about which objects may be mereologically simple: the cosmos and the middle-sized objects that inhabit it are not simple because they exhibit high degrees of qualitative heterogeneity. Within the contemporary scientific worldview, the only plausible candidates as simple objects seem to be some of the microscopic objects studied by fundamental physics, such as elementary particles. That said, it is metaphysically possible that there are macroscopic simples, as long as they are qualitatively homogeneous, since any correlation between size and qualitative homogeneity/heterogeneity seems merely contingent.

Likewise, we cannot rule out *a priori* the existence of elementary particles with the size of a planet, but in the light of the empirical evidence we have about the furniture of this universe, it is highly unlikely that we will ever discover such objects.

Finally, thanks to this negative indicator we can sketch a rational reconstruction of the kind of reasoning by which we discover lower and lower mereological levels in nature: if the objects of the kind *A* exhibit a too complex behaviour, the best way to construct a deeper explanation of phenomena is to attribute to them qualitative heterogeneity. Qualitative heterogeneity requires mereological complexity, and thus the only way to build a deeper explanation is to posit lower-level objects that are the proper parts of the *As*. To put it in a different way, the mereological descent results from the application of an inference to the best explanation together with our negative indicator: this is the way in which natural science has gone from molecules to chemical atoms, then to subatomic particles, then maybe to strings. On the other hand, if we managed to build a fully satisfactory account of the behaviour of *As* without resorting to lower-level explanations, we could invoke a principle of parsimony and conclude that *As* constitute the bottom level of the world. Even if the Brutal View of Simples is true, it seems that we can live with it without tears.

Chapter 8. Elimination Without Tears

Introduction

In the previous chapters, I have defended four interrelated claims about mereology and change: (i) objects endure, rather than perduring or exduring; (ii) there are no compound objects other than mere sums; (iii) every object is ultimately made up of mereological simples; (iv) the only plausible candidate as simples are certain microscopic objects. The conjunction of those claims leads to an eliminative version of Endurance Theory: every object is either a microscopic simple or a mere sum of microscopic simples; both of those kinds of objects endure.

This picture sharply differs from the most common versions of Endurance Theory, according to which there are also integrated wholes, enduring objects that are not mere sums of simples. Needless to say, Eliminative Endurance Theory looks highly revisionary, and it is the target of an obvious common sense reservation: indeed, ordinary objects such as human beings, rocks or chairs do not seem to be mere sums of simples. With this in mind, the present chapter is aimed at showing that Eliminative Endurance Theory is not so revisionary as it might seem at first glance. Moreover, this theory also provides an elegant solution to the puzzle of material constitution and material coincidence, which is an advantage standardly claimed by the defenders of Four-Dimensionalism⁹⁷.

1. Finding a Place for Emergent Causal Powers

A natural objection against Eliminative Endurance Theory is that only compound substances can instantiate emergent dispositions, such as liquidity, fragility and water-solubility; Eliminative Endurance Theory denies the existence of compound substances, so it entails that there are no objects suited to instantiate emergent dispositions. But emergent dispositions seem to be an indispensable ingredient of scientific explanations and, more generally, of all causal explanations: thus, a theory that denies that there are (objects that

⁹⁷ In particular, according to Sider (2001) and Hawley (2001), the ability to solve the puzzles of material constitution and coincidence is the main reason to favour Four-Dimensionalism over Endurance Theory.

instantiate) emergent dispositions is false.

Some qualifications about emergent dispositions are needed. It seems that the dispositions exemplified by compound objects can be of two kinds: summative dispositions, and emergent dispositions. Mass is an example of summative disposition: the mass of a compound object just results from the aggregation of the masses of its proper parts. By contrast, an emergent disposition is a novelty, which is absent at lower mereological levels, though it results from the interactions between lower-level objects. Examples of emergent dispositions are liquidity, fragility and water-solubility. This distinction is far from offering an exhaustive account of a complex issue such as emergence, but I am confident that it is clear enough for the purposes of this chapter.

Given the qualifications above, the present objection is that mere sums may be suited to bear summative dispositions such as mass or charge, but not emergent ones: those can be instantiated only by compound substances – namely, compound objects that do not depend on their proper parts. According to this objection, a compound substance is, in terms of dispositions, something more than the mere sum of its proper parts, since the former has dispositions that the latter lacks. For instance, there are biological powers that are exemplified by Socrates, but not by the mere sum of the proper parts of Socrates. According to this view, the ontology of Eliminative Endurance Theory has no place for emergent dispositions, because those can be exemplified only by compound substances, not by mere sums.

This view entails that it is possible that two objects have exactly the same proper parts, and nonetheless have different dispositions. I am now going to show that this implication contradicts an intuitively plausible principle, that I will call *Principle of Qualitative Equivalence*:

Principle of Qualitative Equivalence: Necessarily, for any numerically distinct objects x and y , if x and y have exactly the same proper parts, then x and y have exactly the same qualities.

One needs to explain what a quality is: to put it in a nutshell, a quality is a property that is both intrinsic and pure. Intuitively, an intrinsic property is a property that an object has only because of the way that very object is, whereas “the extrinsic properties of something may depend, wholly or partly, on something else” (Lewis 1983: 197). Though hard to define, the concept of intrinsicness is clear enough to work with. An impure property is a

property that consists in a relation with certain objects, such as *being the first wife of Napoleon* or *being taller than Michael Jordan*. A property is pure if and only if it is not impure. Not all intrinsic properties are pure: *having Jupiter as part* is intrinsic and impure. Qualities are (all and only) those properties which are both intrinsic and pure: relatively uncontroversial examples of qualities are *being round*, *being red*, and *having a mass of 3 kg*⁹⁸.

The Principle of Qualitative Equivalence is the intuitive principle that which qualities a compound object has is entirely determined by what it is made up of – namely, by its proper parts: therefore, it is impossible that two objects have the same proper parts without having the same qualities as well. As the last of the examples above suggests, at least some dispositions are qualitative properties, since they are both pure and intrinsic. For instance, a salt crystal being water-soluble does not depend on its having any relation with any lump of water: if there was no water in the universe, the salt crystal would still be water-soluble, though being prevented from being actually solved into water; therefore, its water-solubility does not consist of a relation with any particular object. The same line of reasoning can be applied to whatever disposition.

It is worth noticing that it has also been argued that some dispositions are extrinsic, relational properties: for instance, the disposition of my key to open the lock of my front-door seems an extrinsic property, consisting in a relation with the lock of my front-door (Shoemaker 1980; McKittrick 2003). For the sake of the present discussion, here I will use the term “disposition” to refer to standard, pure dispositions, such as mass, charge, fragility, water-solubility and likes. This regimentation is to some extent stipulative, because there is an obvious sense in which even the impure properties above qualify as causal powers. Nevertheless, it is not arbitrary, since the dispositions typically discussed in the literature are pure. Furthermore, they are the most fundamental, because even impure dispositions supervene on them: in the above-mentioned case, the disposition of my key to open the lock of my front-door supervenes on the shape of the lock and on a more basic, intrinsic disposition of the key – namely, the disposition to open locks with that shape (if one prefers to invoke some more robust kind of metaphysical determination, this relationship might be analysed in terms of grounding).

If dispositions are determined by qualitative properties, then the Principle of Qualitative Equivalence has the following principle as a corollary:

⁹⁸ This is the definition of “quality” adopted, among others, by Hawley (2009: 102) and Orilia and Swoyer (2016).

Principle of Causal Equivalence: Necessarily, for any numerically distinct objects x and y , if x and y have exactly the same proper parts, then x and y have exactly the same dispositions.

The Principle of Causal Equivalence states that which dispositions a compound object has is entirely determined by what that object is made up of. Those who object to Eliminative Endurance Theory are committed to the rejection of the Principle of Causal Equivalence and hence of the Principle of Qualitative Equivalence, since the former is entailed by the latter.

Is there anything one can say in defence of the rejection of those principles? One might be tempted to endorse a broadly Aristotelian hylomorphism and argue that the difference in dispositions between Socrates and the mere sum of his proper parts is explained by a *form*: Socrates has a human form, whereas the mere sum of his proper parts has not. To be unified by a form is the mark of a substance such as Socrates as contrasted with a mere aggregate. In particular, there are certain biological properties that flow from the human form that Socrates has and the mere sum of his proper parts lacks⁹⁹. This difference explains why the former has dispositions that the latter does not have.

What makes this account unsatisfactory is that forms qualify as qualitative properties. First of all, a form is a way a certain substance is, and it cannot be present in the world without being borne by an object: those are the marks of properties as contrasted with items from other ontological categories. To be sure, the status of forms as properties is debatable in various respects: for instance, it is controversial whether a form is best viewed as a universal property, which can be multiply instantiated, or a particular property – namely, a property that is particular to one individual substance¹⁰⁰. Likewise, it is debatable whether a form can be analysed as a structural property or not: Koslicki (2008) has argued that it can, Oderberg (2014b) that it cannot. In either case, forms have to be properties, be they universal or particular. In particular, they have to be *qualitative* properties, since they do not consist in any relation with any particular object.

With this in mind, a form belonging to a substance but not to the mere sum of its proper parts is another qualitative difference between them, and thus a violation of the Principle of

⁹⁹ The metaphor of certain properties *flowing* from the essence was first employed by Locke (1975/1690) and it has been recently recovered and worked out by Oderberg (2007, 2011).

¹⁰⁰ It is also controversial which of these options was originally endorsed by Aristotle (Sykes 1975).

Qualitative Equivalence. Forms cannot be invoked to explain the differences in dispositions between substances and the mere sums of their proper parts, because forms would actually be a further *explanandum*: how is it possible that *a* has a form that *b* lacks, given that *a* and *b* have the same proper parts? In conclusion, forms do not help to explain how a substance can have dispositions that the mere sum of its proper parts lacks. It seems that those who endorse the present view would have to take the qualitative difference between them as a brute fact. In this respect, Eliminative Endurance Theory turns out to be better off, because it does not need to deny the Principle of Qualitative Equivalence.

If the rejection of the Principle of Qualitative Equivalence is not viable, the causal objection fails. At this stage, the only alternative available to substance endurantists is to maintain that emergent dispositions are exemplified by both a compound substance and the mere sums of its proper parts: Socrates and the mere sum of its proper parts are numerically distinct, but they have exactly the same dispositions. One might argue that this shows that compound substances do not exist, because they are causally redundant. I do not take causal relevance as the decisive criterion to evaluate the ontological commitment of a theory, so I am not going to make that further step. For the purposes of this chapter, it is sufficient to stress that, according to the present option, Eliminative Endurance Theory is on a par with Substance Endurance Theory when it comes to accommodating dispositions: substance theorists posit objects that eliminative endurantists do not posit, but those objects are causally redundant. With this in mind, the elimination of compound substance is not going to diminish the ability of the resulting ontology to provide causal, naturalistic explanations.

Let us take stock: we have seen that the main premise of the causal objection is implausible, since it contradicts the Principle of Qualitative Equivalence. According to the alternative view available to substance endurantists, Eliminative Endurance Theory is on a par with Substance Endurance Theory. Therefore, when it comes to accommodating emergent dispositions, Eliminative Endurance Theory is, at the worst, on a par with it. In either case, the worry that Eliminative Endurance Theory is ill-suited to accommodate emergent dispositions is doomed.

What if one rejects even the existence of mere sums, and maintains that all objects are mereological simple (that endure)? Those who embrace such a view would still be able to talk about many simples taken together by employing plural quantification. As one can easily see, within such a framework there are no objects suited to instantiate emergent causal powers *singularly*, but one can maintain that many simples can instantiate them

collectively: properties such as fragility, liquidity or water-solubility are exemplified by many simples together.

That being said, is this kind of collective exemplification problematic? As Caves observes, the main argument in favour of collective exemplification is that "... there is a dearth of arguments against it and no obvious cost involved in employing it in our theorizing" (2015: 7). Actually, various statements that we make in ordinary talking are best analysed in terms of collective predication: we say that the members of an orchestra play a symphony together, or that Joel Coen and Ethan Coen co-directed *Fargo*. Here, as in other cases, the appeal to many objects exemplifying a certain property collectively seems the most straightforward way to analyse the logical form of everyday talking. With this in mind, its extension to metaphysical discourse does not seem to involve any additional cost.

If Caves's point is right about the exemplification of qualitative properties in general, then there is no reason why it should not be right about the exemplification of emergent dispositions in particular. Until now, I have argued that mere sums are suited to exemplify emergent dispositions as much as compound substances. Now I want to make a further claim: many simples together are suited to exemplify emergent dispositions as much as mere sums of simples. If the ontology of the Eliminative Endurance Theory is sufficient to accommodate the dispositions invoked in scientific explanation, then the ontology of nihilist endurance theorists is sufficient as well: what is ultimately required to provide a basis for scientific explanation is a furniture of enduring simples. Therefore, the present framework does not count in favour of Mereological Reductionism over Mereological Nihilism. With this in mind, I confirm my agnosticism about the occurrence of mereological composition: in the rest of the chapter, I will keep on talking about mere sums, but those who sympathize with Mereological Nihilism can easily rephrase what I will say in terms of plural quantification and exemplification.

2. What about Ordinary Objects?

A natural objection against the metaphysical picture that I am drawing is that it denies the existence of ordinary objects, which is a highly implausible implication. I am willing to grant that indeed it is not obvious which kind of entities can be identified with ordinary objects within the present picture. According to substance endurance theorists, ordinary objects are identical to certain compound, enduring substances. According to perdurance

theorists, ordinary objects are identical to certain sums of momentary objects. By contrast, the picture sketched by eliminative endurance theorists looks like a mess: we have series of enduring mere sums that have a certain causal, qualitative and spatiotemporal continuity along a certain lifespan; before and after that lifespan, those mere sums are scattered across space in various ways. It seems hard to find ordinary objects such as humans, chairs and stones within this ontology. In this section, I will first frame the issue, by exploring the kind of criterion to assess what counts as an ordinary object. Then, I will show that, by adopting a relaxed yet non-arbitrary criterion, eliminative endurance theorists can find room for ordinary objects in their ontology as well.

First, what is for an object to qualify as an ordinary object? A widespread view about philosophical theoretical terms is that their referents are those entities that are suited to play a certain role: that role is fixed by certain allegedly true statements about them. Those statements can be seen as providing the conditions for certain entities being the referents of the term: for instance, the referents of the term “proposition” are, arguably, those entities suited to be the primary bearers of truth-values and to be the objects of certain mental states. That said, it is worth stressing that “ordinary object” is not a theoretical term, but rather what might be called a *trans-theoretical term*: it is a term that does not denote any ontological category, but it is used to assess how a metaphysical theory performs according to certain *desiderata*, and to confront metaphysical theories with each other.

Indeed, we expect that a category theory might include categories such that of objects, substances, events, or properties, but not a category such as that of ordinary objects: the class of ordinary objects is not of the kind of grouping that we expect to pick up when we are carving nature at the joints. Instead, we talk in terms of ordinary objects when we need to bridge the gap between common sense ontology and our philosophical theory, assessing how the objects that we meet in our every-day experience figure into a deeper picture of reality. For instance, we say that according to a certain metaphysical theory ordinary objects are bundles of tropes, that according to another theory they are bare particulars, and that according to a third theory there are no ordinary objects at all.

Given these qualifications, I maintain that, even in the case of a trans-theoretical term ‘X’, the Xs are those entities that satisfy certain conditions, although those conditions are not related to any theoretical role, but are just platitudes, or “a generally shared body of tacit beliefs” (Lewis 1997b: 333), about Xs. In the present case, we are concerned with platitudes about ordinary objects: no matter what the metaphysical nature of ordinary objects is and in which ontological category they are going to be put, we expect certain

things to be true of them. A list of what we take to be true of ordinary objects is likely to include at least the following points:

- (1) Ordinary objects persist over time. Here “to persist” is to be read as neutral with respect to the debate between Endurance Theory and Four-Dimensionalism: in this neutral reading, both theories are candidates as positing objects that satisfy this requirement.
- (2) Ordinary objects undergo change. As in (1), “change” is to be read as neutral with respect to the debate between Endurance Theory and Four-Dimensionalism. Defenders of Endurance Theory can even claim that Four-Dimensionalism actually rules out genuine change, but that cannot be established just on the ground of an analytic definition of “change” alone, and it would need to be argued (Oderberg 2004).
- (3) Ordinary objects have certain properties: certain sortal properties, and certain non-sortal properties as well. As regards sortal properties, we know that there are ordinary objects that are human beings, others that are cats, others that are stones, and so on. When it comes to non-sortal properties, we know that there are ordinary objects that have properties such as mass, redness, and fragility. Whatever the metaphysical nature of ordinary objects is, we expect that they are the kind of entities that are suited to bear those properties.
- (4) Ordinary objects occupy causal roles. Even if one assumes that events are the ultimate *relata* of causal connections, it is still the case that those events are changes that occur to ordinary objects. This requirement is entangled with the requirements (2) and (3): ordinary objects enter into causal connections in so far as they undergo change, and they have certain causal powers because they exemplify certain dispositional properties.
- (5) Ordinary objects come in certain cardinalities. For instance, we know that currently there are around 7.4 billion human beings on earth: a metaphysical theory that entails that the number of human beings is substantially different is at least *prima facie* missing this requirement.

Now we can state a provisional criterion to assess the commitment of a theory with respect to the existence of ordinary objects: if according to a theory *T* there are no entities that satisfy all of (1) - (5), then the theory *T* entails that there are no ordinary objects.

With this in mind, how do Four-Dimensionalism and the standard versions of Endurance Theory perform according to the list above? In chapters 2, 3, and 4, I have shown that all versions of Four-Dimensionalism miss (3), and hence also (2) and (4): perduring and exduring objects are not suited to bear dispositional properties, so they are suited neither to occupy any causal role nor to undergo change. What about Eliminative Endurance Theory? It seems to satisfy (1), (2), and (4), but whether it can satisfy (3) is less obvious: I have shown that enduring simples and enduring mere sums of simples are suited to instantiate dispositional properties. They seem to be suited to instantiate sortal properties as well: it seems that a mere sum with certain features can be a chair or a human being. The main worry is that this answer seems to miss requirement (5): if we count all the human-shaped mere sums ever existed, then the total number is much greater than the number of human beings that we would expect. Where common sense ontology and Substance Endurance Theory posit just one human being, the present view seems to be committed to the existence of a vast cohort of intimately related human-shaped objects arranged into a series. If one maintains that those human-shaped objects are human beings, then it follows that the number of human beings is much greater than what we expected. It seems that mere sums cannot satisfy both (3) and (5), so, according to Eliminative Endurance Theory, there are no objects that satisfy all of the requirement (1) - (5). Therefore, this view seems to entail that ordinary objects do not exist.

I maintain that the present difficulty can be eluded, provided that one is willing to buy Lewis's more relaxed criterion: Lewis defended the view that the referents of a theoretical term are not necessarily those entities that perfectly realize the related role, but those entities that *best* realize the related role (1994: 489). Therefore, certain entities can count as best realizers even if they realize the relevant role only in an imperfect way. An analogous criterion can be tailored for trans-theoretical terms: the referents of a trans-theoretical term are those entities that best satisfy the related body of beliefs. With this in mind, the *desiderata* for a theory accommodating Xs are to be stated in a less demanding form: a theory entails that there are Xs if and only if its best realizers for 'X' are good enough realizers. This clause is vague, mainly because of the occurrence of the word "enough": to be sure, the threshold between what counts as a good enough realizer and what does not can be hard to assess, and there might be cases where judgment is needed. That being said, this is a kind of vagueness that we expect to meet when evaluating the virtues of a theory: indeed, even standard theoretical values such as parsimony, elegance, explanatory power and initial plausibility all come in degrees.

With this in mind, the identification of ordinary objects with certain mere sums fully matches the requirement (5) when dealing with synchronic counting: once human beings have been identified with certain mere sums, the number of human beings at any given time is equal to the number yielded by common sense ontology. Things are different when it comes to cross-temporal counting: if we count all the mere sums that, at different times, are human beings, then the number is much higher than what we would expect otherwise. With this in mind, it seems that questions like “How many human beings have ever existed?” are to be rephrased in terms of natural series of human beings. As a result, mere sums do not match perfectly the requirement (5); nevertheless, the overall matching with (1) – (5) is still good enough to make them deserve the name of ordinary objects.

The next step is to outline a metaphysical semantics compatible with Eliminative Endurance Theory. The main issue here is to account for proper names, because those seem to have too many candidates as their *denotata*. For instance, there is not exactly one object that deserves to be named “Socrates”: rather, there are many men arranged into a natural series across a certain lifespan, and each of them seems to legitimately bear the name “Socrates”. Here I am going to make an apparently bold claim: all of those mere sums equally deserve to be named “Socrates”. That said, some qualification can help to make this claim look less bold: the reference of proper names such as “Socrates” changes over time, so the name never denotes more than one object at a time. For instance, “Socrates” denotes a certain mere sum in the year 450 BC, and another mere sum in the year 420 BC. One can draw an analogy with the extension of qualitative predicates. Even according to a substance ontology, the extension of predicates such as “pale” changes over time, without necessarily involving the coming into being or passing away of new objects: when Socrates gets tanned, he does not belong to the extension of “pale” any more. Likewise, according to Eliminative Endurance Theory, a certain mere sum is the *denotatum* of “Socrates” at time *t*, and it is not any more at some time later than *t*. The present picture just extends to singular terms a reference model that we are already happy with for general terms: this is still a revision, but a less radical one than it might look at first glance. Given these revisions, the mark of ordinary proper names as contrasted with general terms is not that they have at the most one *denotatum* at all, but that they have at the most one *denotatum* at any time.

Of course, there is still a place for names that are proper *stricto sensu*. For instance, we can name a certain simple *a* and then use that name to refer to it across different times. Likewise, we can single out a certain mere sum by a definitive description, such as “The

mere sum with such-and-such features”; then, we can name that mere sum and use that name to refer to it across different times. Those might be called “singular names” to distinguish them from ordinary proper names like “Socrates” and “Aristotle”. Such names would actually have the semantic traits that we usually attribute to names like “Socrates” and “Aristotle”: (i) they denote at the most one entity at all, and (ii) they denote the same entity across different times. That being said, the reference of ordinary proper names like “Socrates” and “Aristotle” does not match that model.

Other problematic cases for the semantics of Eliminative Endurance Theory are the sentences that involve diachronic sameness. Consider the sentence “The same human being who was blonde is now white-haired”: Eliminative Endurance Theory forces us to deny that this sentence is about exactly one object, and also to deny that here “same” expresses numerically identity. Indeed, according to Eliminative Endurance Theory, we do not have one object that is blonde at a certain time and white-haired at a later time: instead, we have two objects that belong to the same natural series, one of which is blonde at a certain time, whereas the other is white-haired at a later time. With this in mind, one who endorses Eliminative Endurance Theory must maintain that “The same human being who was blonde is now white-haired” is about two numerically distinct objects, and that here “same” expresses some loose kind of sameness, which might be analysed in terms of an appropriate continuity between two numerically distinct objects – which are both members of a certain natural series.

Some further revision is required when we deal with sentences like “The same human being who was aged 10 is now aged 30”. One who endorses Eliminative Endurance Theory must maintain that there is one object that, at a certain time, is 10 years old, and a second object that, at a later time, is 30 years old. Here we need not only to grant that the sentence picks up two distinct objects rather than one, but we also need to maintain that the properties that are being predicated of them are extrinsic: both *being 10 years old* and *being 30 years old* are to be viewed as extrinsic properties that an object has because of its relations with other objects – or, to put it in a different way, because of the position that it occupies in a natural series. This is a further resemblance between the metaphysical semantics of Eliminative Endurance Theory and that of Exdurance Theory: indeed, the view that some seemingly intrinsic properties that we ascribe to ordinary objects are actually extrinsic has been accepted by prominent defenders of Exdurance Theory. For instance, Sider has claimed that mental properties such as *having a belief* are extrinsic (1996: 449); likewise, Hawley has argued that sortal properties are extrinsic: an ordinary

object – which is a momentary object – is a banana because it has temporal counterparts with the appropriate features (2001: 53-4).

Let us take stock. First, we have to acknowledge that the metaphysical semantics of Eliminative Endurance Theory is still more revisionary than that of Substance Endurance Theory or Perdurant Theory: substance endurance theorists maintain that “Socrates” denotes an object that is wholly present at different times, whereas perdurant theorists maintain that “Socrates” denotes a sum of momentary objects. In either case, “Socrates” turns out to denote exactly one and the same object at any time. Moreover, Eliminative Endurance Theory demands certain revisions of the way we talk about ordinary objects, especially of the sentences concerned with diachronic sameness: substance endurance theorists and perdurant theorists can admit that a sentence like “The same human being who was blonde is now white-haired” is concerned with only one object, whereas eliminative endurance theorists cannot admit that. On the other hand, the semantic revisions needed by Eliminative Endurance Theory are similar to those needed by Exdurant Theory: indeed, exdurant theorists also need to maintain that a proper name like “Socrates” changes reference over time, since it denotes a different momentary object at any instant. Likewise, exdurant theorists also have to maintain that a sentence like “The same human being who was blonde is now white-haired” picks up two numerically distinct momentary objects. Finally, both friends of Eliminative Endurance Theory and friends of Exdurant Theory have to accept that some seemingly intrinsic properties that we ascribe to ordinary objects are actually extrinsic.

3. Saving Phenomena

In spite of the defence above, one could be tempted to insist that ordinary objects just are not that way: Socrates in the 450 BC is numerically identical to Socrates in the 420 BC, and the name “Socrates” denotes one and only one man. This is sheer common sense, so a theory that denies such a platitude is obviously false. Those who share this kind of reservation can hardly be convinced in a conclusive way. Nevertheless, I will show that something can be said to tame this common sense objection by offering what Cornell calls *sufficient alternative explanation* (2016: 2401).

First, one has to assess what the rationale behind the common sense objection is: the rationale is provided by the expectation that a theory, be it a scientific or a philosophical

one, *saves phenomena* in the relevant domain. What does a theory need to do in order to save phenomena? To put it in the broadest way possible, a theory, be it a scientific one or a philosophical one, should account for appearances, namely for what seems to be the case: if it seems to be the case that p , then a theory concerned with the relevant domain should explain why it seems to be the case that p . A theory that denies that p gives us a sort of embarrassment: if it is not the case that p , why does it seem to be the case that p ? In the present case, I grant that it does seem to be the case that ordinary objects persist by being wholly present at different times; nevertheless, Eliminative Endurance Theory denies that: here we have a clash between Eliminative Endurance Theory and common sense.

This embarrassment is easily avoided by those theories that offer what might be called *conservative explanation*: it seems to be the case that p because it is the case that p ; this kind of explanation just concedes that common sense got it right. That being said, is endorsing a conservative explanation the only acceptable way to save phenomena? If it was, then there would be no way to respond to the common sense objection against Eliminative Endurance Theory. I contend that to maintain that this is the only acceptable way to save phenomena is too demanding: one must grant that an explanation can be offered even by those theories that can be called *revisionary*; let us say that a theory T is revisionary if and only if there is some proposition ' p ' such that (i) it seems to be the case that p and (ii) T entails that it is not the case that p .

With this in mind, it is reasonable to grant that one can save phenomena also by offering what Cornell calls *sufficient alternative explanation* – namely, an explanation of why it seems to be the case that p although it is not the case that p (2016: 2401). A revisionary theory is prevented from offering a conservative explanation, but it can still provide a sufficient alternative explanation. Such an explanation is enough to save appearances, since it enables a theory T to account for phenomenological data, even if according to T those data are misleading: the theory tells us that we got it wrong, but it can also explain why we got it wrong. In this way, we are freed from the embarrassment of a view that flies against the way in which the world appears to us.

Examples of sufficient alternative explanations abound in natural science. In physics, the theory of relativity tells us that there is no absolute present, which contradicts our naïve time experience. Nevertheless, relativity allows us to explain why it seems that there is an absolute present, since it entails that at speeds much lower than those of light the difference between individual times is negligible. Likewise, microphysics tells us that macroscopic objects are made up of swarms of tiny particles, and that most of the volume occupied by

those macroscopic objects is actually empty of matter. This contradicts our naïve experience, according to which ordinary objects are contiguous and “filled” of stuff. On the other hand, microphysics itself, together with electromagnetism, optics and physiology of perception, can explain why it seems to us that those objects are contiguous and full; this is the two tables example famously discussed by Eddington in his popular writings (1928).

As in natural science, instances of sufficient alternative explanations occur in various areas of philosophy when a theory denies some commonsensical beliefs. Act-utilitarians standardly defend their theory from the common sense objection by arguing that common sense moral norms are useful rules of thumb, which in most circumstances help us to pick up the optimific action. This strategy amounts to a sufficient alternative explanation, since it is aimed at explaining why we are victims of certain moral illusions. In metaphysics, mereological nihilists standardly account for the appearance that there are chairs by maintaining that there are mereological simples that are arranged chair-wise. Likewise, Cornell (2016) has applied this strategy to the defence of existence monism – namely, the view that the cosmos is mereologically simple. Existence monism contradicts the appearance according to which the cosmos is made up of a plurality of subcosmic objects: to explain the appearance of plurality, Cornell invokes patterns of distributable qualities. Those qualities, spread in certain ways across the cosmos, generate the appearance that the cosmos itself is mereologically complex, whereas it is actually simple. Here I am not claiming that these attempts to provide a sufficient alternative explanation are as successful as those of natural science: what I am trying to stress is that this kind of strategy is common in contemporary philosophy; indeed, it is invoked every time that a theory flies in the face of common sense.

When it comes to the present issue, the problem with Eliminative Endurance Theory is that it seems to us that, for instance, Socrates in the 450 BC is numerically identical to Socrates in the 420 BC; but Eliminative Endurance Theory just denies this. Nevertheless, a sufficient alternative explanation is easily available to its defenders: mere sums are arranged into series whose members exhibit a spatiotemporal, causal and qualitative continuity; this continuity grounds the seeming that there is one object that is numerically identical across time, whereas actually there are many objects arranged into a series. If, by contrast, the world was made up of scattered mere sums of simples, there would be no seeming of the existence of compound continuants. With this in mind, the illusion that there are compound substances is due to the causal structure of the world: in possible worlds where simples are scattered, no such appearance arises.

It is worth clarifying what is the dialectical strategy at work here. A theory T offering a sufficient alternative explanation for certain appearances does not provide a direct argument in favour of T , but only a way to respond to a certain objection. If it seems to be the case that p and T entails that it is not the case that p , then one has a *prima facie* case against T ; if a sufficient alternative explanation of why it seems to be the case that p is available, then that *prima facie* case is defeated. The only dialectical role of a sufficient alternative explanation is to neutralize the common sense objections against a theory. If a revisionary theory is not already supported by any argument, its being able to save phenomena does not give us any reason to accept it. With this in mind, the positive case for my Eliminative Endurance Theory is offered by the previous chapters; this section was only aimed at providing a response to the common sense objection.

4. The Statue and the Lump of Clay

In the remaining part of this chapter, I will argue that Eliminative Endurance Theory has certain theoretical virtues that Substance Endurance Theory lacks. This virtue, on top of the argument outlined in chapter 5, provides a further case for Eliminative Endurance Theory over more traditional varieties of Endurance Theory. In particular, I will show that Eliminative Endurance Theory delivers a solution to puzzles of the statue and the lump of clay that is structurally similar to that delivered by Four-Dimensionalism. This is going to be a major dialectical point, because that solution is often considered to be the main reason for Four-Dimensionalism over Endurance Theory: if an analogous solution can be offered by Eliminative Endurance Theory as well, then this version of Endurance Theory is on a par with Four-Dimensionalism, when it comes to solving the puzzles of material constitution.

The puzzle concerns the relationship between a statue and the lump of clay that the statue is made of: let us call “David” the former and “Lump” the latter. Those seem to be two numerically distinct objects, because there are times when the lump exists, but the statue does not: in particular, Lump existed before that David was created. Likewise, there are modal differences between them: indeed, there are possible worlds where Lump exists, but David does not, because Lump is never shaped to create it. On the other hand, David and Lump seem to have exactly the same proper parts at every time when they co-exist. If David and Lump are numerically distinct, then there is a counter-example to the

Extensionality Principle, according to which, for any objects x and y , if x and y have exactly the same proper parts, then x is identical to y . Furthermore, David being numerically distinct from Lump entails that two distinct objects can occupy exactly the same location at the same time (or occupy the same spatiotemporal region), which is counter-intuitive.

The solution to this puzzle standardly invoked by endurance theorists is to actually reject the Extensionality Principle, admitting the possibility of numerically distinct objects that have exactly the same proper parts: in the present case, they would argue that, at any time when they co-exist, David and Lump have exactly the same proper parts; nevertheless, they are numerically distinct (Thomson 1983). Likewise, they are exactly co-located for all the time that they co-exist.

Unlike those who endorse Substance Endurance Theory, four-dimensionalists can accept that David and Lump are distinct without denying the Extensionality Principle. Within Perdurant Theory, David and Lump can be identified with objects that are distinct yet mereologically overlapping. Indeed, David is a proper temporal part of Lump: all of the temporal parts of David are temporal parts of Lump as well, but Lump also has earlier and later temporal parts, which exist before that David comes into being and after that David passes away. According to Endurance Theory, there is a series of statues and a series of lumps, and those series overlap: all the members of the former are also members of the latter, but the latter has earlier and later members that the former does not have.

Defenders of Eliminative Endurance Theory can offer an analogous solution, which is that there are two series of enduring objects – namely, a series of statues and a series of lumps – and those series also overlap: all the members of the former are also members of the latter, but the latter has earlier and later members that the former does not have. The eliminative solution and the endurantist solution to the puzzle are very similar in structure: both the theories invoke two overlapping series of objects, with one of the two being a segment of the other; the most extended series is made up of candidates as the lump only, whereas the lesser one is made up of candidates as both the lump and the statue. If the solutions are structurally similar, the underlying ontology is nonetheless different: according to Endurance Theory, the members of those series are momentary objects; according to Eliminative Endurance Theory, those members are enduring objects.

Like the four-dimensionalist solution, the eliminative solution does not entail that there are mereologically disjoint objects that are co-located. Likewise, it does not entail that there are distinct objects that have exactly the same proper parts. To sum up, Eliminative

Endurance Theory can claim to have one of the main virtues standardly ascribed to Four-Dimensionalism, which is to deliver an attractive solution to the puzzle of the statue and the lump of clay.

Conclusions

I will end this work overviewing the dialectical positions of Eliminative Endurance Theory, Substance Endurance Theory, and Four-Dimensionalism. In chapter 1, I have proposed a novel way of framing the debate between Endurance Theory and Four-Dimensionalism, by focusing on change rather than persistence. This approach to the debate has informed my discussion in the chapters 2-8. However, none of the arguments that I have worked out in those chapters depends on the regimentation of Endurance Theory and Four-Dimensionalism that I have defended in chapter 1: with this in mind, my exploration of Eliminative Endurance Theory is to be taken into consideration even by those who prefer to frame the debate in terms of persistence or presence-at-a-time.

In chapter 2, I have shown that a standard argument in favour of Four-Dimensionalism over Endurance Theory – namely, the Argument from Temporary Intrinsic – fails. In chapter 3, I have outlined my first argument in favour of Endurance Theory over Four-Dimensionalism: four-dimensionalists, be they perdurance theorists or exdurance theorists, can hardly find a place for dispositions within their ontology, whereas endurance theorists can accommodate them in a straightforward way. In chapter 4, I have outlined a further argument in favour of Endurance Theory: endurance theorists can easily explain why objects endure or pass away, whereas four-dimensionalists have a hard time accounting for the continuous replacement of momentary objects. Taken together, chapter 3 and chapter 4 show that we have strong reasons to prefer some version of Endurance Theory to Four-Dimensionalism.

In chapter 5, I have shown that there are reasons to deny the existence of enduring compounds other than mere sums: if chapters 3 and 4 have shown that we have reasons to choose Endurance Theory over Four-Dimensionalism, chapter 5 also shows that we have reasons to choose an eliminative version of Endurance Theory over the standard versions. In chapters 6 and 7, I have explored what can be said in favour of a traditional version of metaphysical atomism, according to which all objects are ultimately made up of microscopic simples. In this chapter, I have summarized the view resulting from the

previous ones and I have further explored what can be said in its defence. First, I have defended Eliminative Endurance Theory from some obvious objections. Second, I have argued that, when it comes to addressing the puzzles of material constitution, Four-Dimensionalism cannot claim any advantage over Eliminative Endurance Theory, but only over Substance Endurance Theory: indeed, Eliminative Endurance Theory can offer a solution analogous to the one offered by Exdurance Theory, hence claiming a virtue that has been often considered to be the main case in favour of Four-Dimensionalism.

Needless to say, none of the arguments that I have presented in this work is definitive and each of them can be challenged or eluded by paying some cost. For instance, further refinements of the naturalness-free versions of the Best System Account might ultimately enable four-dimensionalists to find room for dispositions within their ontology. Likewise, the argument in favour of metaphysical atomism that I have outlined in chapter 6 loses its force if one is willing to accept the possibility of undetermined objects – namely, objects that lack an ultimate individuation – or if one endorses a view of fundamentality different from Mereological Fundamentalism. All the arguments that I have presented in chapters 3, 5, and 7 can be also eluded at the cost of biting some bullet. In this chapter, I have addressed the objections against my view, but none of my responses is a knock-down one: for instance, one might find a way to reject the Principle of Causal Equivalence; alternatively, one might simply contend that my theory does not meet the requirements set out in section 2, or that the semantical revisions that it requires are too demanding. More generally, Eliminative Endurance Theory remains a rather revisionary view, so the commonsensical reservations against it cannot be dissolved completely.

With the caveats above in mind, in this work, I have shown how one can make a case for Eliminative Endurance Theory as a comprehensive and defensible picture of change, persistence, and material composition, over both Four-Dimensionalism and the standard versions of Endurance Theory. In conclusion, Eliminative Endurance Theory is a view that deserves to be further explored.

Bibliography

- Aczel, P. (1988). *Non-Well-Founded Sets*, CSLI Lecture Notes Number 14, Stanford, CA: CSLI Publications.
- Abelard, P. (1970). *Dialectica*, 2nd Ed., ed. L. M. De Rijk, Assen: Van Gorcum.
- Aristotle (1984). *The Complete Works of Aristotle: The Revised Oxford Translation*, Vol. 2, ed. J. Barnes, Princeton: Princeton University Press.
- Arlig, A. (2013). Some Twelfth-Century Reflections on Mereological Essentialism, in *Oxford Studies in Medieval Philosophy*, ed. R. Pasnau (Oxford: Oxford University Press): 83-112.
- Armstrong, D. M. (1983). *What Is a Law of Nature?*, Cambridge: Cambridge University Press.
- Bacon, J. (1995). *Universals and Property Instances: The Alphabet of Being*, Oxford: Blackwell.
- Baxter, D. L. M. (1988). Identity in the Loose and Popular Sense, in *Mind*, 97 (388): 576-82.
- Bayle, P. (1709/1991). *Historical and Critical Dictionary: Selections*, trans. R. H. Popkin, Indianapolis: Hackett.
- Bennett, J. (1984). *A Study of Spinoza's Ethics*, Indianapolis: Hackett Publishing.
- Bennett, J. (1991). Spinoza's Monism: A Reply to Curley, in *God and Nature: Spinoza's Metaphysics*, eds. Y. Yovel (Leiden: E. J. Brill): 53-60.
- Benocci, M. (2017). Priority Monism and Essentiality of Fundamentality: A Reply to Steinberg, in *Philosophical Studies*, 174 (8): 1983-90.
- Bigelow, J., B. Ellis and C. Lierse (1992). The World as One of a Kind: Natural Necessity and

- Laws of Nature, in *The British Journal of the Philosophy of Science*, 43 (3): 371-88.
- Bird, A. (2007). *Nature's Metaphysics: Laws and Properties*, Oxford: Oxford University Press.
- Blackburn, S. (1990). Filling in Space, in *Analysis*, 50 (2): 62-5.
- Boolos, George (1971). The Iterative Conception of Set, in *The Journal of Philosophy*, 68 (8): 215-31.
- Brogaard, B. (2000). Presentist Four-Dimensionalism, in *The Monist*, 83 (3): 341-56.
- Cameron, R. P. (2007). The Contingency of Composition, in *Philosophical Studies*, 136 (1): 99-121.
- Cameron, R. P. (2008). Turtles All the Way Down: Regress, Priority and Fundamentality, in *Philosophical Quarterly*, 58 (230): 1-14.
- Campbell, K. (1990). *Abstract Particulars*, Oxford: Blackwell.
- Carriero, J. (1995). On the Relationship Between Mode and Substance in Spinoza's Metaphysics, in *Journal of the History of Philosophy*, 33 (2): 245-73.
- Casati, R. and A. Varzi (1999). *Parts and Places*, Cambridge, MA: MIT Press.
- Caves, R. L. J. (2018). Emergence for Nihilists, in *Pacific Philosophical Quarterly*, 99 (1): 2-28.
- Chisholm, R. (1973). Parts as Essentials to Their Wholes, in *The Review of Metaphysics*, 26 (4): 581-603.
- Chisholm, R. M. (1976). *Person and Object: A Metaphysical Study*, La Salle, IL: Open Court Publishing Company.

- Cornell, D. M. (2016). Taking Monism Seriously, in *Philosophical Studies*, 173 (9), 2397-415.
- Costa, D. (2017) The Transcendentist Theory of Persistence, in *Journal of Philosophy*, 114 (2): 57-75.
- Curley, E. (1969). *Spinoza's Metaphysics: An Essay in Interpretation*, Cambridge, MA: Harvard University Press.
- Curley, E. (1991). On Bennett's Interpretation of Spinoza's Monism, in *God and Nature: Spinoza's Metaphysics*, ed. Y. Yovel (Leiden: E. J. Brill): 35-52.
- Dasgupta, S. (2016). Metaphysical Rationalism, in *Noûs*, 50 (2): 379-418.
- Dehmelt, H. (1989). Triton,... Electron,... Cosmon,...: An Infinite Regression?, in *Proceedings of the National Academy of Science*, 86 (22): 8618-19.
- Dipert, R. (1997). The Mathematical Structure of the World: The World as a Graph, in *The Journal of Philosophy* 94 (7): 329-58.
- Eddington, A. (1928). *The Nature of the Physical World*, New York: MacMillan.
- Ehring, D. (1997). Lewis, Temporary Intrinsic, and Momentary Tropes, in *Analysis*, 57 (4): 254-8.
- Ellis, B. (2001). *Scientific Essentialism*, Cambridge: Cambridge University Press.
- Elder, C. (2004). *Real Natures and Familiar Objects*, Cambridge, Mass.: MIT Press.
- Elder, C. (2011). *Familiar Objects and Their Shadows*, Cambridge: Cambridge University Press.
- Fine, K. (1994). Ontological Dependence, in *Proceedings of the Aristotelian Society*, 95: 269-90.

- Georgi, H. (1989). Effective Quantum Field Theories, in *The New Physics*, ed. P. Davies (Cambridge: Cambridge University Press): 446-57.
- Gilmore, C. S. (2004). *Material Objects: Metaphysical Issues*, Princeton University Dissertation.
- Gilmore, C. S. (2006). Where in the Relativistic World Are We?, in *Philosophical Perspectives*, 20: 199-236.
- Gilmore, C. S. (2018). Location and Mereology, in *The Stanford Encyclopedia of Philosophy*. ed. E. N. Zalta. URL = < <https://plato.stanford.edu/entries/location-mereology/> >
- Goff, P. (2010). Orthodox Truthmaker Theory Cannot Be Defended by Cost/Benefit Analysis, in *Analysis*, 70 (1): 45-50.
- Hall, N. unpublished mn. Humean Reductionism About Laws of Nature, URL= < <http://philpapers.org/archive/HALHRA.pdf> >.
- Hall, N. (2015). Humean Reductionism About Laws of Nature, in *A Companion to David Lewis*, eds. B. Loewer and J. Schaffer (Oxford: Blackwell): 262-77.
- Haslanger, S. (1989). Endurance and Temporary Intrinsic, in *Analysis*, 49 (3): 119-25.
- Hawley, K. (1999). Persistence and Non-Supervenient Relations, in *Mind* 108 (429): 53-67.
- Hawley, K. (2001). *How Things Persist*, Oxford: Clarendon Press.
- Hawley, K. (2009). Identity and Indiscernibility, in *Mind*, 118 (469): 101-19.
- Hawley, K. (2015). David Lewis on Persistence, in *A Companion to David Lewis*, eds. B. Loewer and J. Schaffer (Oxford: Blackwell): 237-49.
- Hinchliff, M. (1996). The Puzzle of Change, in *Philosophical Perspectives*, 10: 119-36.

- Horgan, T. and M. Potrč (2000). Blobjectivism and Indirect Correspondence, in *Facta Philosophica*, 2 (2): 249-70.
- Horgan, T. and M. Potrč (2012). Existence Monism Trumps Priority Monism, in *Spinoza on Monism*, ed. P. Goff (Palgrave Macmillan): 51-76.
- Ingram, D. and J. Tallant (2015). Nefarious Presentism, in *Philosophical Quarterly*, 65 (260): 355-71.
- Jenkins, C. S. (2011). Is Metaphysical Dependence Irreflexive?, in *The Monist*, 94 (2): 267-76.
- Jenkins, C. S. and D. Nolan (2012). Disposition Impossible, in *Noûs*, 46 (4): 432-53.
- Kleinschmidt, S. (2017). Refining Four-dimensionalism, in *Synthese*, 194 (11): 4623-40.
- Koslicki, K. (2008). *The Structure of Objects*, Oxford: Oxford University Press.
- Koslicki, K. (2012). Varieties of Ontological Dependence, in *Metaphysical Grounding: Understanding the Structure of Reality*, eds. F. Correia and B. Schnieder (Cambridge: Cambridge University Press): 186-213.
- Leibniz, G. W. (1765/1996). *New Essays on Human Understanding*, trans. and eds. J. Bennett and P. Remnant, Cambridge: Cambridge University Press.
- Leibniz, G. W. (1989). *G. W. Leibniz: Philosophical Essays*, eds. R. Ariew and D. Garber, Indianapolis: Hackett Publishing.
- Levinson, J. (2006). Why There Are No Tropes, in *Philosophy*, 81 (4): 563-79.
- Lewis, D. K. (1968). Counterpart Theory and Quantified Modal Logic, in *The Journal of Philosophy*, 65 (5): 113-26.
- Lewis, D. K. (1983a). Extrinsic Properties, in *Philosophical Studies*, 44 (2): 197-200.

- Lewis, D. K. (1983b). New Work for a Theory of Universals, in *Australasian Journal of Philosophy* 61 (4): 343-77.
- Lewis, D. K. (1986a). *On the Plurality of Worlds*, Oxford: Blackwell.
- Lewis, D. K. (1986b). *Philosophical Papers, Volume II*, Blackwell, Oxford.
- Lewis, D. K. (1988). Rearrangement of Particles: Reply to Lowe, in *Analysis*, 48 (2): 65-72.
- Lewis, D. K. (1991). *Parts of Classes*, Oxford: Blackwell.
- Lewis, D. K. (1994). Humean Supervenience Debugged, in *Mind*, 103 (421): 473-90.
- Lewis, D. K. (1997a). Finkish Dispositions, in *Philosophical Quarterly*, 47 (187): 143-58.
- Lewis, D. K. (1997b). Naming the Colours, in *Australasian Journal of Philosophy*, 75 (3): 325-42.
- Lewis, D. K. (2009). Ramseyan Humility, in *Conceptual Analysis and Philosophical Naturalism*, eds. D. Braddon-Mitchell and R. Nola (Cambridge, MA: MIT Press): 203-22.
- Locke, J. 1690 (1975). *An Essay Concerning Human Understanding*, ed. P. H. Nidditch, Oxford: Clarendon Press.
- Loewer, B. (1996). Humean Supervenience, in *Philosophical Topics* 24 (1): 101-27.
- Loewer, B. (2007). Laws and Natural Properties, in *Philosophical Topics* 35 (1/2): 313-28.
- Lowe, E. J. (1988). The Problem of Intrinsic Change: A Rejoinder to Lewis, in *Analysis*, 48 (2): 72-7.
- Lowe, E. J. (1998). *The Possibility of Metaphysics: Substance, Identity, and Time*, Oxford: Oxford University Press.

- Lowe, E. J. (2006). *The Four-Category Ontology: A Metaphysical Foundation for Natural Science*, Oxford: Oxford University Press.
- Markosian, N. (1998). Simples, in *Australasian Journal of Philosophy*, 76 (2): 213-26.
- Markosian, N. (2004). Simples, Stuff, and Simple People, in *The Monist*, 87 (3): 405-28.
- Marmodoro, A. (2013). Aristotle's Hylomorphism Without Reconditioning, in *Philosophical Inquiry*, 37 (1-2): 5-22.
- Martin, C. B. (1994). Dispositions and Conditionals, in *Philosophical Quarterly*, 44 (174): 1-8.
- Mathews, G. B. (2002). On the Idea of There Being Something of Everything in Everything, *Analysis*, 62 (1): 1-4.
- Maudlin, T. (2007). *The Metaphysics Within Physics*, Oxford: Oxford University Press.
- McDaniel, K. (2007a). Brutal Simples, in *Oxford Studies in Metaphysics*, Vol. 3, ed. D. W. Zimmermann (Oxford: Oxford University Press): 233-65.
- McDaniel, K. (2007b). Extended Simples, in *Philosophical Studies*, 133 (1): 31-41.
- McDaniel, K. (2009). Extended Simples and Qualitative Heterogeneity, in *The Philosophical Quarterly*, 59 (235): 235-41.
- Merricks, T. (1998). Against the Doctrine of Microphysical Supervenience, in *Mind*, 107 (425): 59-71.
- Merricks, T. (1999). Persistence, Parts, and Presentism, in *Noûs*, 33 (3): 421-38.
- Merricks, T. (2001). *Objects and Persons*, Oxford: Clarendon Press.

- Merricks, T. (2005). Composition and Vagueness, in *Mind*, 114 (455): 615-37.
- Miller, E. (2014). Quantum Entanglement, Bohmian Mechanics, and Humean Supervenience, in *Australasian Journal of Philosophy* 92 (3): 567-83.
- McKittrick, M. (2003). A Case for Extrinsic Dispositions, in *Australasian Journal of Philosophy*, 81 (2): 165-74.
- Molnar, G. (2003). *Powers: A Study in Metaphysics*, Oxford: Oxford University Press.
- Mumford, S. (2003). *Dispositions*, Oxford: Clarendon Press.
- Mumford, S. (2004). *Laws in Nature*, London and New York: Routledge.
- Oderberg, D. S. (2004). Temporal Parts and the Possibility of Change, in *Philosophy and Phenomenological Research*, 69 (3): 686-708.
- Oderberg, D. S. (2006). Instantaneous Change Without Instants, in *Analytical Thomism: Traditions in Dialogue*, eds. C. Paterson and M. S. Pugh (Aldershot: Ashgate): 101-17.
- Oderberg, D. S. (2007). *Real Essentialism*, London: Routledge.
- Oderberg, D. S. (2011). Essence and Properties, in *Erkenntnis*, 75 (1): 85-111.
- Oderberg, D. S. (2014a). Being and Goodness, in *American Philosophical Quarterly*, 51 (4): 345-56.
- Oderberg, D. S. (2014b). Is Form Structure?, in *Neo-Aristotelian Perspectives in Metaphysics*, eds. D. D. Novotný and L. Novák (London: Routledge): 164-80.
- Orilia, F. and C. Swyer (2016). Properties, in *The Stanford Encyclopedia of Philosophy*, ed. E. N. Zalta. URL = <<https://plato.stanford.edu/entries/properties/>>
- Parsons, J. (2000). Must Four-Dimensionalists Believe in Temporal Parts?, in *The Monist*, 83

(3): 399-418.

Parsons, J. (2004). Distributional Properties, in *Lewisian Themes: The Philosophy of David K. Lewis*, eds. F. Jackson and G. Priest (Oxford: Oxford University Press): 173-80.

Parsons, J. (2007). Theories of Location, in *Oxford Studies in Metaphysics*, Vol. 3, ed. D. W. Zimmerman (Oxford: Oxford University Press): 201-32.

Putnam, H. (1982). Why There Isn't a Ready-Made World, in *Synthese* 51 (2): 141-67.

Quine, W. V. O. (1969). Natural Kinds, in *Ontological Relativity and Other Essays* (New York: Columbia University Press): 114-38.

Quine, W. V. O. (1976). Whither Physical Objects?, in *Essays in Memory of Imre Lakatos*, eds. R. S. Cohen, P. K. Feyerabend, and M. W. Wartofsky (Dordrecht: Reidel): 497-504.

Rundle, B. (2004). *Why There Is Something Rather Than Nothing*, Oxford: Oxford University Press.

Schaffer, J. (2001). The Individuation of Tropes, in *Australasian Journal of Philosophy*, 79 (2): 247-57.

Schaffer, J. (2003). Is There a Fundamental Level?, in *Noûs*, 37 (3): 498-517.

Schaffer, J. (2007). From Nihilism to Monism, in *Australasian Journal of Philosophy*, 85 (2): 175-91.

Schaffer, J. (2009a). On What Grounds What, in *Metametaphysics: New Essays on the Foundations of Ontology*, eds. D. Chalmers, D. Manley and R. Wasserman (Oxford: Clarendon Press): 347-83.

Schaffer, J. (2009b). Spacetime the One Substance, in *Philosophical Studies*, 145 (1): 131-48.

Schaffer, J. (2010a). Monism: The Priority of the Whole, in *Philosophical Review*, 119 (1):

31-76.

Schaffer, J. (2010b). The Internal Relatedness of All Things, in *Mind*, 119 (474): 341-76.

Schaffer, J. (2012). Grounding, Transitivity, and Contrastivity, in *Metaphysical Grounding: Understanding the Structure of Reality*, eds. F. Correia and B. Schnieder (Cambridge: Cambridge University Press): 122-38.

Shoemaker, S. (1980). Causality and Properties, in *Time and Cause: Essays Presented to Richard Taylor*, ed. P. van Inwagen (Dordrecht: Reidel): 109-35.

Schwarz, W. (2015). Analytic Functionalism, in *A Companion to David Lewis*, eds. B. Loewer and J. Schaffer (Wiley-Blackwell): 504-518.

Sider, T. (1993). Van Inwagen and the Possibility of Gunk, in *Analysis*, 53 (4): 285-9.

Sider, T. (1996). All the World's a Stage, in *Australasian Journal of Philosophy*, 74 (3): 433-53.

Sider, T. (2000). The Stage View and Temporary Intrinsic, in *Analysis*, 60 (1): 84-8.

Sider, T. (2001). *Four-Dimensionalism: An Ontology of Persistence and Time*, Oxford: Oxford University Press.

Sider, T. (2003). Maximality and Microphysical Supervenience, in *Philosophy and Phenomenological Research*, 66 (1): 139-49.

Sider, T. (2007a). Parthood, in *Philosophical Review*, 116 (1): 51-91.

Sider, T. (2007b). Against Monism, in *Analysis*, 67 (1): 1-7.

Sider, T. (2008). Monism and Statespace Structure, in *Being: Developments in Contemporary Metaphysics*, ed. R. Le Poidevin (Cambridge: Cambridge University Press): 129-50.

- Sider, T. (2011). *Writing the Book of the World*, Oxford: Oxford University Press.
- Sider, T. (2013). Against Parthood, in *Oxford Studies in Metaphysics*, Vol. 8, eds. K. Bennett and D. W. Zimmerman (Oxford: Oxford University Press): 237-93.
- Simons, P. M. (1987). *Parts: A Study in Ontology*, Oxford: Clarendon Press.
- Simons, P. M. (2004). Extended Simples: A Third Way Between Atoms and Gunk, in *The Monist*, 87 (3): 371-84.
- Sisko, J. (2005). Anaxagoras and Recursive Refinement, in *Ancient Philosophy*, 25: 239-45.
- Skow, B. (2007). Are Shapes Intrinsic?, in *Philosophical Studies*, 133 (1): 111-30.
- Spencer, J. (2010). A Tale of Two Simples, in *Philosophical Studies*, 148 (2): 167-81.
- Spencer, J. (2014). Two Thoughts on “A Tale of Two Parts”, in *Res Philosophica*, 91 (3): 485-90.
- Sykes, R. D. (1975). Form in Aristotle: Universal or Particular?, in *Philosophy*, 50 (193): 311-31.
- Teller, P. (1983). Quantum Physics, the Identity of Indiscernibles and Some Unanswered Questions, in *Philosophy of Science*, 50 (2): 309-19.
- Teller, P. (1986). Relational Holism and Quantum Mechanics, in *British Journal for the Philosophy of Science*, 37 (1): 71-81.
- Thomson, J. J. (1983). Parthood and Identity Across Time, in *The Journal of Philosophy*, 80 (4): 201-20.
- Tooley, M. (1977). The Nature of Laws, in *Canadian Journal of Philosophy*, 7 (4): 667-98.
- Van Inwagen, P. (1990). *Material Beings*, Ithaca, NY: Cornell University Press.

Van Inwagen, P. (2006). Can Mereological Sums Change Their Parts?, in *The Journal of Philosophy*, 103 (12): 614-30.

Williams, D. C. (1953). On the Elements of Being: I, in *The Review of Metaphysics*, 7 (1): 3-18.