BUNDLE THEORY WITH KINDS

By Markku Keinänen[1] and Tuomas E. Tahko[2]

Is it possible to get by with just one ontological category? We evaluate L.A. Paul's attempt to do so: the mereological bundle theory. The upshot is that Paul's attempt to construct a one category ontology may be challenged with some of her own arguments. In the positive part of the paper we outline a two category ontology with property universals and kind universals. We will also examine Paul's arguments against a version of universal bundle theory that takes spatiotemporal co-location instead of compresence or coinstantiation as the feature by which we can identify genuine bundles. We compare this novel theory, bundle theory with kinds, and Paul's mereological bundle theory and apply them to a case study concerning entangled fermions and co-located bosons.

Keywords: bundle theory, categories, universals, natural kinds, kind universals, formal ontology.

I. INTRODUCTION[1]

Over the last decade and a half, L.A. Paul (2002, 2006, 2012, 2013, 2017) has developed a sophisticated version of universal bundle theory, the 'mereological bundle theory'. The theory aims to produce a one category ontology, which goes toward collapsing the distinction between substance and property: substances turn out to be merely mereological complexes of properties and hence not an ontological category in their own right. The precursors of this type of view include the trope bundle theories of Keith Campbell (1990); Williams (1953); Simons (1994), as well as Russellian bundle theory, which takes objects to be bundles of universals. These views share the virtue of parsimony, since they attempt to get by with just one fundamental ontological category. Unlike in traditional substance-attribute accounts, in these views properties are not, fundamentally, properties *of* objects, since the properties themselves are more fundamental than the objects they constitute. Rather, properties are particular

---

or universal natures from which objects are constructed (cf., e.g. Campbell 1990: 20). But operating with just one category comes with its costs as well: all the traditional bundle theories must account for the problem of distinguishing between the bundles (of properties) that constitute objects and mere collections of properties. The classic attempts to deal with this problem involve the introduction of new primitives, such as 'compresence' or 'coinstantiation'.

Another difficulty for universal bundle theories concerns the validity of the principle of identity of indiscernibles – does the bundle theory rule out distinct objects with exactly the same pure properties that stand in exactly the same (pure) relations? In answering this question, bundle theorists divide roughly into two groups. According to some of them (e.g. O'Leary-Hawthorne (1995) and Curtis (2014)), the bundles constituted by the identical universals are themselves multi-located objects. Others deny this and introduce different kinds of additional constructions like instances of bundles (Rodriguez-Pereyra 2004), bundles of instances (Zhang 2018), or non-reducible but dependent objects (Benocci 2018) to allow for distinct objects 'grounded in' exactly the same universals. Finally, Paul (2017) does not introduce such additional constructions but maintains that exactly the same universals can be parts of distinct objects having primitive identity conditions.

In this paper, we develop a novel version of bundle theory, which starts from bundles of property universals – like traditional Russellian bundle theory – but also includes substantial kind universals. Nevertheless, we deny the existence of objects even as entities constituted by or dependent on universals. There are only *mere pluralities* of property universals taking some of the roles standardly assigned to objects. The resulting view is a two category ontology, involving two types of universals, which may be understood as subcategories of one fundamental category of universals. We will argue that the loss of parsimony, if any, that this entails compared to traditional one category ontologies is more than made up for by the fact that our version of bundle theory, bundle theory with kinds, can address many of the problems faced by the one category versions, including Paul's mereological bundle theory. We aim to examine what it would take to truly eliminate objects from the fundamental furniture of reality without introducing 'universal-like' multi-located objects or additional 'object-like' constructions.[2]

Since we regard Paul's version of universal bundle theory to be the most sophisticated, we will focus on her version. In what follows, we will first outline our own theory and motivate the introduction of kind universals. Our solution uses bundles (understood as mere pluralities) of properties as substitutes for

[2] One might ask how this novel version of bundle theory compares with traditional two category ontologies, whereby both substances and properties are fundamental categories. This would deserve a discussion of its own, but we suggest that there are reasons to favour the bundle theory, as it commits us to just one fundamental type of category, namely, universals.

objects and identifies the relevant pluralities in terms of spatiotemporal co-location instead of compresence or coinstantiation, as we will explain in the next section. We will then address some of the objections that Paul and others have raised against this type of solution and compare our theory against Paul's. We'll also briefly show how kind universals can be put to broader use elsewhere, to better justify their introduction. Next, in section III, we identify some initial challenges for a bundle theory of the type we wish to develop, focusing on spatiotemporal co-location. In section IV, we will argue that sophisticated as it is, Paul's theory as well suffers from some of the traditional problems that bundle theories face. Finally, in section V we will put our theory to test by applying it to some of the most challenging cases for bundle theory, such as the case of entangled fermions and co-located bosons, which would appear to be particularly problematic for a view that uses co-location as a basis for identifying the relevant, object-replacing bundles. Our solution involves the introduction of complex universals. We conclude that bundle theory with kinds is a serious contender among bundle theories and in fact it is preferable to Paul's version: first, it avoids problematic methodological moves such as primitive individuation and construction of distinct entities from the same proper parts (we shall discuss both below). Second, it avoids re-introducing the primitive distinction between particulars and universal properties.

II. AN OUTLINE OF A BUNDLE THEORY WITH KINDS

As mentioned in the introduction, bundle theory with kinds involves two fundamental ontological categories. They are both species of universals, the first being familiar type of *property universals* and the second what may be called *substantial kind universals*. On this view, bundles of property universals instantiate kind universals. For instance, an electron consists of the property universals *mass*, *charge*, and *spin* and stands in the relation of instantiation to the kind universal *electron*. Our understanding of the instantiation relation is somewhat similar to Lowe's (2006, 2009), as we consider instantiation as a primitive formal ontological relation between 'objects' (here, bundles of universals) and kind universals. As a formal ontological relation, instantiation is not an additional entity in our theory but it holds solely because of the existence of its relata.[3] One should not be misled by the fact that the term 'instantiation' is often used precisely to express the relation between objects and the properties that they instantiate. Since we introduce two fundamental categories of universals,

---

[3] See Simons (2003) and Lowe (2006: Ch. 3) for a similar conception of formal ontological relations. Moreover, formal ontological relations are internal relations in the sense that they hold necessarily, given the existence of their relata, cf. Lowe (2012) and Keinänen, Keskinen and Hakkarainen (2017: Sec. 2).

we consider instantiation as the formal ontological relation between the two fundamental categories of universals that the proposed ontology includes.[4]

It may be worth highlighting, again, that according to our bundle theory, there are no objects in the usual sense; objects are at best a useful fiction. Indeed, we regard it a potential problem for bundle theories that bundles of universals are usually thought of as individuals. We wish to eschew this idea altogether. To avoid confusion, let us introduce a novel term. Instead of talking about 'objects' or even bundles, we regard a collection of property universals to be a *caboodle* – 'a collection of things'. Caboodles are not individuals; they are not objects. Caboodles are pluralities of property universals that instantiate one or more kind universals and each property universal must be in some caboodle that instantiates a kind universal. Employing instantiation does not make the view more costly than traditional bundle theory, which instead appeals to a new primitive (namely, 'comprescence'). The term 'caboodle' is not a primitive, it is merely a placeholder term for a plurality of property universals. Obviously, caboodles themselves are not going to do very much work in the theory, that's why we need kind universals and require that every property universal is in a caboodle that instantiates a kind universal. Note however that we will also continue to use the term 'object' below for ease of exposition when discussing competing views.

There is another motivation for the introduction of kind universals, which is an additional similarity with Lowe's theory and our own. This motivation is related to the work that kind universals do elsewhere, especially with regard to laws of nature. We will return to this below.[5] For reference, we include Lowe's own illustration of his four-category ontology (or 'ontological square', reproduced from Lowe 2006: 22; Figure 1).

We are sympathetic to Lowe's distinction between substantial and non-substantial universals, but as is clear from Figure 2, the view being developed here differs from Lowe's four-category ontology quite significantly, because instantiation holds between kind universals and pluralities of property universals (caboodles) instead of objects (Lowe's individual substances).

One immediate attraction of the view is that kind universals may be considered to do much of the work that individuals do in traditional theories. Caboodles always instantiate a kind universal. This is of course not enough by itself, since we would also like to be able to distinguish, say, one electron from another. To do this, traditional bundle theorists have introduced novel

---

[4] Like in some other universal bundle theories, in our system, properties are universals because they fulfil the principle of identity of indiscernibles. See Ehring (2011: Sec. 1) for a defence of the particular-universal distinction in terms of this principle. Moreover, all kind universals are entities that have instances, but they do not instantiate anything. Thus, they *also* fulfil this separate condition set for universals, e.g., by E.J. Lowe (2015: 76–9).

[5] See also Hommen (2019) for a very recent defence of the need to postulate substantial kind universals.

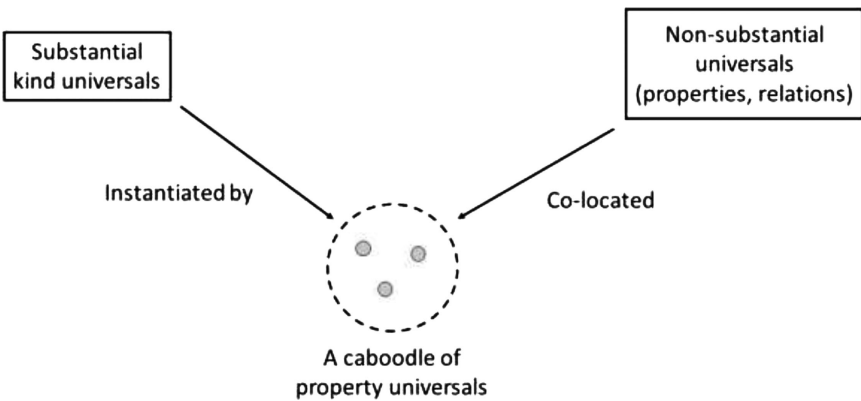**Figure 1.** The 'ontological square', reproduced from Lowe 2006: 22.

Figure 2. Bundle theory with kinds.

primitives such as compresence or coinstantiation, but we think that the ideological cost of this move can be avoided by relying, instead, on the spatiotemporal co-location of the property universals. The kind universal 'picks out' a caboodle of property universals, but it is in terms of the spatiotemporal colocation of those universals that we identify the object-replacing caboodles. This move, the employment of spatiotemporal co-location, raises an obvious problem for bundle theory: if we were to take locations as the relata of spatiotemporal relations, then how are we supposed to understand the nature of the locations? On our view, it will not do to consider them as substances. We take it that property universals are concrete, that is, spatiotemporally located

entities. Moreover, universals are capable of being wholly present and exactly located in multiple places at the same time (see Gilmore 2014: Sec. 4.1).

There are at least two potential ways to understand this account. The first would be to develop on a suggestion by Cody Gilmore (2003), which accounts for the location of universals as relata of the basic spatiotemporal relations and defends concrete universals against problems raised by Douglas Ehring (2002). Ehring argues that if universals are instantiated in spacetime and have spatial relations non-derivatively, then this gives rise to contradictory spatial relations. Consider two universals U and V at time t:

> U and V are each instantiated twice at [time] t, once each at the North and the South Pole, perfectly overlapping at each Pole. U at the North Pole is north of V at the South Pole and U at the South Pole is not north of V at the North Pole. (Ehring 2002: 21.)

Hence, universals U and V are wholly present in both spatial locations (the South Pole and the North Pole). Consequently, *U is north of V*. Moreover, *V is north of U*, which entails that *U is not north of V*. A contradiction.

To avoid such contradictory relations, Gilmore assumes that the spatial locations of universals are also relata of the spatial relations. Hence, two universals U and V are related by a four-place spatial relation having the spatial locations of U and V as their further relata. This solution could easily be extended to spatiotemporal relations between universals, although we won't develop this approach further here. However, since we have kind universals at our disposal, we can suggest an alternative account.

This second possible solution takes every spatiotemporal location as being determined by a distinct kind universal. Every location is, as it were, a way of being. We do not take locations as additional entities, but postulate instead that caboodles of property universals may instantiate distinct *locational kind universals* corresponding to each of its locations. A caboodle of property universals can instantiate distinct locational kind universals (because certain property universals can be located in distinct places) but there may also be caboodles that instantiate a single locational kind universal. We acknowledge that this requires a fairly liberal notion of a 'kind', but we are already operating with a somewhat revisionary notion, since we conceive of kinds as universals.[6] We did not include locational kind universals above in Figure 2, but their role is fairly straightforward. Yet, an acute reader may consider this picture to be circular: if co-location is used to explain what can instantiate a substantial kind universal, then co-location itself cannot be explained by the instantiation of a

---

[6] Locational kind universals fulfil two of the criteria set for universals discussed in the recent literature: they fulfil the principle of identity of indiscernibles and must have (one or more) instances in order to exist (cf. footnote 4). We do not consider there to be any need for introducing locational kind universals for possible empty locations. Similarly, spatiotemporal relations between 'objects' are determined by locational kind universals that the bundles of universals instantiate.

substantial kind universal.[7] This is correct, but the order of explanation that we propose does not go quite like this. We propose instead that the pluralities (caboodles) of property universals instantiate substantial kind universals and locational kind universals. Every property universal must be in some (one or more) caboodle instantiating a substantial kind universal. Moreover, every caboodle of property universals instantiating a substantial kind universal must instantiate one or more locational kind universals. Thus, the basic idea is that substantial kind universals 'collect' a group of property universals, which then instantiate a locational kind universal in order to have a location.

Our theory introduces two sorts of *generic dependencies*: first, between caboodles of property universals and some (but not any specific) kind universals which they instantiate, and second, between the same caboodles and some (but not any specific) locational kind universals. Moreover, we adopt a four-dimensionalist conception of the temporally continuous existence of 'objects'.[8] According to our view, 'temporally continuous objects' are construed by means of a caboodle instantiating a substantial kind universal and locational kind universals that make a spatiotemporally continuous set of locations. Although these sequences are not individuals, kind universals can be used to account for the existence of object-like sequences: the existence of a caboodle instantiating kind K in a spatiotemporally continuous set of locations amounts to the existence of 'a temporally continuous object of kind K'.

So, there are at least two ways to respond to the worry about the nature of spacetime on this type of account. With each proposal, the aim is to avoid taking spatiotemporal locations themselves as further entities.[9]

III. INITIAL CHALLENGES FOR A BUNDLE THEORY WITH KINDS

We can now move on to some further challenges that a bundle theory relying on spatiotemporal co-location will face. In developing her version of mereological bundle theory, Paul has raised some serious problems for competing bundle theories. Mereological bundle theory is supposed to be an improvement

---

[7] This was pointed out by an anonymous referee for this journal.

[8] See Sider (2001) and Hawley (2001) for defences of exdurantist four-dimensionalism. For reasons of space, we leave the discussion of the relation between our account and the different four-dimensionalist theories of objects to another occasion.

[9] It might be added here that the nature of spacetime is a problem for anyone who attempts to construct a bundle theory of this type. Other moves could be considered here as well. For instance, Paul, in developing her mereological bundle theory, goes for relational spacetime. More precisely: objects can be understood as 'located in spacetime (by being qualitative fusions that are fused with spatiotemporal relations or relational properties)' (Paul 2017: 34). But it's not clear that this solution will work, given Ehring's counterexample, without assuming something like Gilmore's account.

over traditional bundle theory, since it takes the primitive relation of bundling to be just the familiar relation of composition, whereby properties or property instances can be parts of objects. Paul thus hopes to avoid the cost of introducing a new primitive (such as compresence or coinstantiation) to address this problem, but regards spatiotemporal co-location as an even more problematic solution. Even though our theory does not involve a commitment to objects, we use co-location in picking out the caboodles that play the object roles in our theory. Therefore, we must also deal with these difficulties:

> Taking sameness of location as a sufficient condition for objecthood is unacceptable: (i) contemporary physics cannot be right if it implies that numerically distinct particles or things can occupy the same place at the same time, (ii) numerically distinct interpenetrating material objects are impossible, (iii) unlocated objects are impossible, and (iv) questions like those about the relation between the statue and the clay that constitutes it are decided by fiat. A primitive notion of "coinstantiation" is better. (Paul 2002: 580.)

To clarify, the cases that Paul presumably has in mind with regard to (i) are things like entangled fermions or co-located bosons (she discusses these in more detail in Paul 2017).[10] These are admittedly tricky cases, but we will postpone a detailed treatment of these cases until section V. At this point, it suffices to say that we need to bring in *complex* universals to address this challenge. However, for now we'd like to focus on Paul's objections (ii)–(iv). As it happens, our reply also serves to motivate the introduction of kind universals, for we believe that all three of these objections can easily be diffused with the help of kind universals.

Let's start with (ii): numerically distinct interpenetrating material objects are impossible. This is clearly a problem if we have nothing but spatiotemporal co-location to go by when identifying material objects (or 'objects'). One could, perhaps, simply bite the bullet here and insist that interpenetrating material objects are indeed impossible. But since we have kind universals at our disposal, this is not necessary. This is because two material objects of different *kinds* can certainly exist in the same place at the same time without there being any issue about their identification, even if they were to share all their properties.[11] This brings us directly to (iv), which is a case in point: the statue and the lump of clay that constitutes it are indeed interpenetrating and appear to

---

[10] We note that there are further complications to consider with such examples. Whether bosons may be 'co-located' in the relevant sense is open to interpretation, see e.g. Gilmore (2014: Sec. 4.3) and Pashby (2016). Following Paul, we will continue to speak as if such co-location is possible, leaving these complications aside.

[11] An anonymous referee points out that this strategy will not help with a case of same-kind coincidence, such as in Kit Fine's (2000) famous case of two coinciding letters written on two sides of the same piece of paper. We agree that the case of same-kind coincidence needs to be treated separately, although there may be very few plausible examples of such coincidence. Our discussion, in section V, will focus on what we regard as the most plausible case, namely, coinciding bosons.

share all their properties. But 'statue' and 'lump' evidently represent different kinds of material object and hence we can say that the statue would not, e.g., survive a change in its shape whereas the lump would. The same caboodle of property universals constituting the statue *and* the lump instantiates two distinct kind universals. Moreover, the kind universal introduces a criterion of identification, which may be used to distinguish interpenetrating material objects. Accordingly, both objections (ii) and (iv) may be addressed.

Paul's objection (iii), regarding the impossibility of unlocated objects, is somewhat trickier, although we do not consider it very serious: one could bite the bullet in this case as well and deny the possibility of unlocated objects. For one thing, *material* objects are always spatiotemporally located, so if there are unlocated objects, they cannot be material. This leaves us with abstract objects. Here we would like to remain neutral. For those who wish to deny the existence of abstract objects, biting the bullet is the desirable option. But there is a potential solution available to those who think that there are (unlocated) abstract objects as well, for one could say that objects of the kind 'abstract object' are *unique* and thus need not be distinguished in terms of their location. In other words, there is only one of each subspecies of the kind 'abstract object', such as the number '2'. It's not that we need to pick out *this* number '2' and *that* number '2' in terms of their respective locations, since there is only one of them and it can be readily picked out simply with the help of the relevant kind universal. Moreover, although the number '2' may also be regarded to belong to the more general abstract kind 'number', it's perhaps reasonable to think that each number could be a sub-kind of this more general kind, not unlike each locational kind universal can be conceived of as a sub-kind of the general kind 'location'. So, the idea here is that the kind universal does a similar job in the case of abstract objects as the locational kind universals do in the case of material objects. In this case, there is no caboodle of concrete property universals that needs to be located. Abstract objects, on this type of view, would be individual kind universals. This leaves us only Paul's objection (i) to deal with; we will return to it in section V.

What remains to be done in this section is to provide some further motivation for the postulation of substantial kind universals. So far, we have shown that kind universals are very useful in addressing Paul's objections to traditional bundle theory, but to avoid the apparent *ad hoc* flavour of introducing them only for this purpose, we should like to point out that there are entirely independent reasons to do so. One case in favour of kind universals is familiar from Lowe (2006, 2009, 2015). More recently, David Hommen (2019) has argued in favour of 'an irreducible category of kinds' on the basis of the need to postulate them to address the problem of unity: kind membership explains why certain properties always occur together. Lowe argues that we need no less than four fundamental categories to do all the usual work assigned to a system of ontological categories. As we saw in Figure 1 (section II), Lowe distinguishes

two different kinds of universal – exactly as we do – besides the categories of tropes (or modes, as he calls them) and particulars: substantial kind universals and non-substantial universals (properties/relations). Kind universals play a complex role in Lowe's overall theory, but we need only point out one central motivation for them, namely, the work that they do in grounding laws of nature.

Any complete account of ontological categories had better say something about how categories are related to laws of nature and Lowe has already developed a sophisticated theory about the relationship between laws and kinds. More precisely, Lowe proposes that we should explain laws in terms of the natures of natural kinds. The kind *electron*, for instance, has it as a part of its nature that its instances have unit negative charge. This essentialist fact can then help to explain various law-like regularities, such as the net negative charge of those ions that have extra electrons.

Instead of considering laws as relations between property universals (like in the Dretske-Tooley-Armstrong theory, e.g. Armstrong 1997: 223ff.), Lowe considers the truthmakers of laws as properties and relations that characterize kind universals. In a bundle theory, such as the one being constructed here, it is straightforward to introduce the laws of nature accounting for the essential properties of given natural kind *K*. Consider electrons, which have determinate mass *m*, electric charge *-e* and spin quantum number $\frac{1}{2}$ as their essential properties. What accounts for the clustering of these three property universals as necessary properties of the kind electron? As Lowe (2015: Sec. 6) points out, property universals and, say, the Armstrongian second-order necessitation relations between them cannot do the job. The main problem here is that a set of monadic property universals (like mass *m*, electric charge *-e* and spin quantum number $\frac{1}{2}$) are clustered to constitute essential properties of a natural kind in some of their co-located occurrences but fail to occur together in others. For instance, muons can have the same spin quantum number and electric charge as electrons but they have a considerably larger mass.

To solve this problem, we propose that caboodles of property universals instantiate substantial kind universals (such as *electron* or *muon*). By instantiating these kind universals, they (or some of them) constitute the essential properties of the corresponding natural kinds. Since 'objects' are nothing but caboodles of co-located property universals that instantiate kind universals, the occurrence of a caboodle instantiating one or more kinds in a certain location determines what different kinds of objects are in that location.

We do not mean to suggest that one should adopt Lowe's full-blown essentialist framework to enable the type of bundle theory that we are here constructing, but it may be useful to see that the account could be naturally combined with this type of analysis of laws. We take it that this is enough to show that postulating kind universals cannot be deemed an *ad hoc* move in response to Paul's objections.

IV. A CRITICAL STUDY OF MEREOLOGICAL BUNDLE THEORY

In this section, we will consider Paul's latest development and defence of mereological bundle theory (Paul 2017). We will show that one of Paul's own critical remarks concerning traditional bundle theory applies equally to her own mereological bundle theory. We have in mind the objection that traditional bundle theory is implicitly committed to two categories (object and property) after all. Paul's critique is based on the traditional bundle theorist's understanding of properties as *parts*:

> To the extent that there is an ontological distinction drawn between the natures of the concrete objects and their concrete parts, and the abstract particulars or universals that are their qualitative constituents, traditional bundle theory starts to endorse the neo Aristotelian's distinction between properties and individuals. And, as I have argued, to the extent that one holds that properties are not literally parts, one holds that properties are not objects, which suggests, if not a categorical difference between the real natures of these things, something very like it. (Paul 2017: 43)

Paul has D.C. Williams in mind here. She concludes that the traditional bundle theorist seems to have implicitly endorsed a categorial distinction between properties and objects (as bundles of properties). Paul herself insists that there is no such distinction; her ontology is truly a one category ontology.

This brings us to another obvious challenge for a one category ontology based on bundle theory: the individuation of numerically distinct but qualitatively indiscernible objects (see Paul 2017: 47ff.). The classic example of a symmetric world with two perfectly homogeneous iron spheres is a case in point: how does the bundle theorist account for the distinctness of the spheres if there is nothing but the (intrinsic and extrinsic) properties of the spheres to tell them apart? To undercut this challenge, Paul proposes to deny a crucial premise of the challenge, which she calls the *supervenience of identity* thesis: 'the property of *being identical to x* reductively supervenes on *x*'s pure (intrinsic and extrinsic) properties' (Paul 2017: 49). Now, to deny this thesis, Paul considers two options: (1) accept haecceities or impure properties as constituents of bundles, or (2) endorse primitive individuation. Paul goes for (2), arguing that there is an 'ungrounded difference' (Paul 2017: 50) between the two iron spheres in question – 'identity facts simply supervene on the objects themselves' (*ibid.*). Paul compares this move to that made by some trope bundle theorists (cf. Campbell 1990: Sec. 3.7), whereby tropes are primitively individuated. In fact, she recommends this move also to the traditional (Russellian) bundle theorist.

Our worry here is that Paul ends up falling prey to her own challenge. The thought is simple: if we need to assign non-reducible primitive identity conditions to bundles of properties, thus denying the supervenience of identity thesis, then we have implicitly introduced a fundamental criterion to distinguish

between objects and properties. This implicit criterion would appear to be 'if not a categorical difference between the real natures of these things, something very like it' – to re-iterate Paul's own concern (Paul 2017: 43).

Quite generally, this type of primitive distinction in terms of non-reducible identity conditions is the very definition of a *categorial* distinction.[12] As Lowe puts it: 'ontological categories are individuated by the distinctive existence and/or identity conditions of their members' (Lowe 2006: 6). According to the formal ontological approach, which Lowe adopts and which we are using here, the basic formal ontological relations between an entity and other entities together with its identity conditions determine the category to which the entity belongs. So, if it turns out that we have assigned distinctive identity conditions to some type of entity (in this case, bundles of properties) which are *not* reducible to the identity conditions of its parts (property universals), then we have introduced a new type of entity with distinctive category features. Thus, we have also introduced a category distinction between the entity itself (the bundle) and the properties of which it consists.[13]

The formal ontological approach allows one to specify higher categories to which entities with different identity conditions belong. For instance, in Lowe's four-category ontology, the category of objects is one of the four basic categories, which has more specific categories of objects (e.g. persons, living organisms) as its sub-categories. On this understanding of categories, different identity conditions mark out a category distinction among the entities belonging to the higher category (cf. Thomasson 2018: Sec. 2.3). As Thomasson notes, this idea, namely that 'category distinctions among objects may be drawn out in terms of the identity and/or existence conditions associated with terms of each category' (*ibid.*), has recently been gaining popularity. Accordingly, we believe it to be a reasonable approach.

Let us now apply this idea to Paul's theory. On closer analysis, Paul introduces a general category of 'properties' which has two distinct sub-categories:

---

[12] Compare with the different strategies for reducing one ontological category to another discussed in Nolan (2011). If there is no way to do this i.e. if there ends up being a *primitive* distinction between two candidates for categories, then a natural conclusion is that there *are* two distinct categories.

[13] In a one category trope bundle theory, for instance, objects are considered as identity dependent on tropes, their identity conditions are determined by the identity conditions of (some) of their trope constituents, cf. Lowe (1998: 205ff.) and Keinänen and Hakkarainen (2014: Sec. 3). See also Rodriguez-Pereyra (2004) for a case in favour of numerically distinct but perfectly similar particulars. If successful, this type of strategy might help Paul to avoid our objection. This would require that two particulars can have exactly the same constituents: 'When a bundle is in a place, there is also another entity there, namely an *instance* of the bundle. The instance is entirely constituted by the universals of the bundle. But the instance and the bundle are two distinct entities' (Rodriguez-Pereyra 2004: 78). While this strategy is certainly clever, we do not think that it avoids our objection, since by introducing an instance of the bundle, the bundle theorist is effectively once again introducing non-reducible primitive identity conditions to bundles of properties as distinct from their instances.

first, the standard property universals, which fulfil the principle of identity of indiscernibles, and second, objects (or, mereological sums of properties), which do not satisfy the principle because the supervenience of identity thesis fails for them. Thus, on a plausible conception of the universal-particular distinction (cf. footnote 4), Paul introduces a category distinction between universals and particulars (or 'objects') within the higher category of 'properties'.

Returning to our own theory, it is important to note that bundles of properties are to be distinguished from caboodles, since caboodles *are* reducible, given that they are pluralities of property universals. This is a clear advantage of the view that we propose over Paul's theory, since resorting to primitive individuation regarding the two homogenous iron spheres results in the introduction of an implicit category distinction. Therefore, Paul's denial of the supervenience of identity thesis does not hold any advantage in comparison with how she considers the situation in the context of the traditional bundle theory i.e. that there is an implicit commitment to two fundamental ontological categories.

The upshot of this discussion is that Paul's challenge for traditional bundle theory is alive and well, and it is equally threatening to mereological bundle theory. This makes us wonder if we might have been better off with an explicit commitment to two categories at the outset. Our own proposal, as outlined earlier, is to go this way, albeit with two categories of universal rather than those of object and property, which can, perhaps, itself be considered more parsimonious, given that we only deal with universals. Admittedly, our theory as well may be challenged with the scenario concerning the two iron spheres, as it is an assumption of the scenario that the world containing the iron spheres is symmetric and hence we cannot easily resort to the location of the individual spheres to tell them apart. A partial solution to this problem would be to adopt locational kind universals as we proposed earlier, since they can specify a location without reference to other locations, and so they may be able to give us *weak discernibility* even in a symmetric situation. But more needs to be said about the details here: we have said nothing about the nature of spacetime and the specifics of the solution would depend on this. We will return to weak discernibility below, although the relationship between locational kind universals and the nature of spacetime is something we leave for further research. We now turn to scientifically motivated cases of indistinguishable, co-located objects.

V. CASE STUDY: ENTANGLED FERMIONS AND CO-LOCATED BOSONS

In this section we return to one of Paul's original objections against a location-based analysis of 'objecthood': 'contemporary physics cannot be right if it

implies that numerically distinct particles or things can occupy the same place at the same time' (Paul 2002: 580). In her more recent work, Paul (2017: §2.6) develops the relevant idea in more detail, noting that we must, one way or another, account for the existence of systems that consist of two or more indistinguishable objects. These could be systems of entangled fermions or co-located bosons (e.g. 2-boson states). Paul argues that thinking of such systems as truly consisting of two or more particles is misleading, since quantum particles are not 'objects' in any usual sense. However, since we must account for the phenomenon somehow, more needs to be said. Paul proposes that we might just have to introduce further irreducible properties to address this problem, such as '2-boson-ness' or '3-boson-ness'. She explains these properties as follows: 'the irreducibly intensive properties of these quantum states are internally unstructured in that they are not reducible to conjunctions or coinstantiations of multiple instances of unit quantities such as *being a boson* or *being boson A*' (Paul 2017: 57). But while this solution does of course do the trick, we find the cost of introducing further ontologically basic properties such as '2-boson-ness' (and indeed '*n*-boson-ness') to be rather high, even if it is an understandable move if one wishes to preserve the identity of indiscernibles in this context. So, it is worth asking: can we do any better?

We believe that we can, by resorting to complex quantity universals. In developing an account of complex quantity universals, we will make use of Keith Campbell's (1990: Secs. 4.3–4.4) analogous theory of complex properties as *conjunctive compresences* of simple properties. As a trope theorist, Campbell takes all properties to be particulars (i.e. tropes). Moreover, he considers the quantity tropes falling under a determinable (e.g. mass tropes) as complex tropes, namely, conjunctive compresences formed by tropes of the smaller units of the same quantity. The basic idea behind this is very simple. Two distinct mutually co-located quantity tropes falling under the same determinable, such as two mass tropes t and u form a complex trope whose quantitative value amounts to the sum of the values of t and u. If t is a 1 kg trope and u is a 2 kg trope that are mutually co-located, together they form a complex 3 kg trope v. More generally, every bundle of mutually co-located (i.e. compresent) tropes constitutes a complex trope, a *conjunctive compresence*, whose quantitative value amounts to the value of the sum of the constituent tropes.

The view being developed here assumes, contra Campbell, that properties are universals instead of tropes. In order to construct an analogous account for property universals, let us make a further assumption: a single property universal, in addition to having multiple locations, can be multiply located in a *single spatiotemporal position*. Take, for instance, the universal for the elementary charge, e. We assume that a caboodle of property universals can instantiate a locational kind universal once, twice or several times. The property universal of elementary charge is multiply located in a single spatiotemporal position if there is a corresponding caboodle of property universals (e.g. the caboodle

constituted by the necessary properties of a positron), which instantiates the corresponding locational kind universal multiple (twice or more) times. By being multiply located in a single spatiotemporal position, this universal, call it *u*, can form complexes with itself and other co-located charge universals. Thus, if the universal *u* is located twice in a single spatiotemporal position, it forms a *complex universal* with the value 2*e*.

Campbell takes tropes to be independent existents capable of existing without being accompanied by other tropes. In our theory, property universals can exist independently of other *property* universals, but they must be conceived as constituents of caboodles that necessarily instantiate some *kind* universal. By this we simply mean that nothing in our theory entails that two different *property* universals must be constituents of a given caboodle. In other words, even though a property universal *P* must be constituent of some caboodle *C* that instantiates a fixed kind universal *K*, there is nothing about *P* that demands that a distinct property universal P^* is also a constituent of *C*. However, this does leave open the possibility that it's necessary, say, for colour universals to be constituents of caboodles where we also have a shape universal.[14] This is something that could be entailed by the kind universal instantiated in the caboodle. Nevertheless, this is not directly entailed by our theory.

Here is one upshot. Take property universals -*e*, electron mass *m* and spin quantum number $\frac{1}{2}$, which instantiate the kind universal electron. Since caboodles of property universals can instantiate a locational kind universal twice or more times, there can be complexes of the same universal in a single spatiotemporal location. Thus, we could have co-located complexes of two unit negative charges, two mass universals, and two spin universals. A caboodle of these universals instantiates the kind universal electron. Since the universals of the basic states of an electron are each located twice in that region of space-time, there are, in a manner of speaking, 'two electrons' in that region. The reason why it's appropriate to say that there are *only* two electrons in this region is because each kind universal 'electron' requires one instance of each property universal. Since the property universals are always instantiated in caboodles that have the relevant kind universal, they cannot be combined willy-nilly so that we would have *more* than two electrons in a location with only two counts of each property universal. Finally, it should be noted that we hold, as Lowe (2012) does, that instantiation is an *internal* relation. It is necessary for a kind universal that it is instantiated by a given caboodle of property universals and it can also be necessary for a locational kind universal that it specifies the location of a given caboodle or caboodles. It can still be contingent for a caboodle to instantiate a given locational kind universal, while it is necessary to the same (locational and substantial) kind universals to be instantiated by the given caboodle.

---

[14] Thanks to an anonymous referee for pushing us on this issue.

Notice that the foregoing does not commit us to Gonzalo Rodriguez-Pereyra's (2004) view (mentioned in footnote 13), where *instances* of bundles, here the 'two electrons', and bundles themselves can be distinguished. On our view, in a system with 'two electrons', the property universals constituting the caboodle of universals instantiating the kind universal electron are all located twice in a single spatiotemporal position. Therefore, we can say that there are 'two electrons' here. But we are willing to accept that there is no way to *epistemically* distinguish them: only resorting to primitive individuation would seem to enable this. Nevertheless, since we can rely on kind universals, we can easily count these electrons ('objects') without any commitment to instances of caboodles as distinct from the caboodles – in our theory, the kind universals do the work that instances of bundles do for Rodriguez-Pereyra. Furthermore, since we hold that property universals must always be constituents of some caboodle that instantiates a kind universal, there is no possibility of any 'free-floating' property universals that would interfere with the count. So, there is a way to *metaphysically* count how many 'objects' of a certain kind there are. And what does make it the case that there are two 'objects'? The fact that there are two counts of all the relevant property universals.[15]

This distinction between epistemic and metaphysical distinguishability is the distinction between how we can *tell* that two putatively distinct entities are indeed distinct and what *makes it the case* that they are distinct. We find it important to draw this distinction, given our epistemic limitations when it comes to examples involving things like entangled quantum systems. Taking advantage of this distinction, it is possible to make sense of both the idea that a system of two entangled fermions or a 2-boson system contains two 'objects' and the perhaps scientifically more respectable idea that such systems ought to be considered as a whole – as complexes. This is because we can *count*, say, how many co-located charge universals there are in such a system (so we can metaphysically distinguish them) even if these universals are properly speaking constituents of just one complex (and hence epistemically indistinguishable). Hence, not only can we avoid postulating properties such as '2-boson-ness', but we can also salvage the (folk) idea that there are multiple 'objects' participating in such a system.

One minor cost of this view is that we do need to make a commitment to complex universals. But Campbell's theory presents a respectable analogue

---

[15] Note that since caboodles are already pluralities, not individuals, we cannot count them. What we can count are (1) property universals; (2) property universals instantiating kind universals (such as different kinds of particles); (3) property universals in specific locations (electrons). Since a caboodle of property universals instantiates a kind universal (e.g. electron) and a locational kind universal, we can pick out an 'object' in some specific location. There are of course no genuine objects according to our theory, but we can consider there to be an 'object' that fills this role. Moreover, if the relevant property universals are located twice in that location, there are two 'objects' of the specific kind in that location.

of the idea and we might also point to David Armstrong (1978: Ch. 15; 1997: 33; see also Lewis 1986: 30) who argues at some length in favour of complex universals.[16] Others, like Hawley and Bird (2011), invoke complex universals primarily to account for natural kinds, whereas we have primitive kind universals to take care of that. However, because we have kind universals at our disposal, our view requires resorting to complex universals only in cases where we have co-located objects of the same kind. As far as we know, there are very few kinds that are capable of being co-located in this manner, perhaps only bosons (but even this is controversial). So, presumably there are not very many complex universals – they would seem to be necessary only in the peculiar cases of certain elementary kinds. Accordingly, we regard the cost of complex universals for our overall theory to be relatively small.

Finally, let us briefly return to the case of the two homogenous iron spheres. Now that we have introduced complex universals, one might wonder why we couldn't apply them in the case of the iron spheres as well. The reason is simple. Symmetry prevents us from individuating the spheres in terms of their spatiotemporal location, but we also cannot say that the spheres are spatiotemporally co-located. We may note again that iron spheres are not objects of the appropriate *kind* to enable co-location – only bosons would seem to be capable of such behaviour. One remaining alternative would be to adopt the idea developed by O'Leary-Hawthorne (1995) and O'Leary-Hawthorne and Cover (1998), whereby we could take the spheres to be a multiply-located, numerically unique object (see Morganti 2011 for discussion). The idea may seem natural enough, for why couldn't we think that objects could be multiply-located exactly like individual universals are? Well, in our theory, this possibility is explicitly ruled out. Recall that we pick out 'objects' in terms of their location, for 'objects' are just caboodles of property universals that instantiate kind universals. So, in the case of the iron spheres, if there is an instantiation of a kind universal and two distinct locational kind universals by a caboodle of property universals, then it appears that there must be two 'objects', even though we can't tell which one is which.

What can we say about this case? We are in fact inclined to bite the bullet. If there truly is no difference between the spheres and it is assumed that symmetry rules out distinguishing them in terms of their location, then we simply cannot (epistemically!) distinguish them. But notice that the situation is

---

[16] An anonymous referee presents us with a worry based on Lewis's (1986) critical remarks on Armstrong's use of complex universals: how can we *metaphysically* distinguish co-located yet distinct complexes instantiating the same kind universal in a single location from a single, multiply located complex instantiating a kind universal in a single spatiotemporal position? The solution is to distinguish the complexes strictly in terms of the relevant locational kind universal, which are instantiated in the complexes. This is also how our version differs from Armstrong's. In the case of distinct complexes in a single location, we can only count the complexes, so there is no epistemic way to distinguish them. But where multiple locations are involved, we can distinguish the different complexes with the help of distinct locational kind universals.

not as dramatic as it might first seem, for it only arises in a perfectly symmetric universe; normally, we can distinguish caboodles in terms of their location. In fact, the situation resembles the case of entangled fermions.[17] In the case of entangled fermions, we might appeal to the possibility of *weak discernibility*.[18] The idea here is that there is at least an irreflexive physical relation that each fermion in an entangled system stands in. Even though electrons in a singlet state have the same mass and charge, and neither has a determinate location or momentum, there is nevertheless an irreflexive relation that holds between them, i.e., something like '... has opposite direction of each component of spin to ...', as Saunders (2003) suggests. In the case of the iron spheres, the relevant irreflexive relation would concern the distance between the spheres i.e. 'sphere A is one mile apart from sphere B'.

There are, of course, problems with this idea. As Hawley (see e.g. Hawley 2006: 302) notes, absolute space isn't allowed in the picture – we just have the 'two spheres' without a specific location, one mile apart. But weak discernibility nevertheless allows us to say that regardless of this epistemic limitation, the relevant instantiations of locational kind universals by a caboodle of universals that constitute the two spheres are instantiations of *distinct* locational kind universals (and hence they are *metaphysically* distinguishable). This is guaranteed by the distinctness of the locational kind universals. Moreover, if we apply our earlier suggestion, that there are distinct locational kind universals for each spatiotemporal location, we have all the necessary tools to apply weak discernibility to this case. Spheres A and B (more precisely, the caboodles of universals) will instantiate different locational kind universals, so they are (at least) weakly discernible.

How does our proposed solution fare with regard to the well-known Russellian objection according to which weak discernibility already presupposes the distinctness of the spheres, as a difference in relation presupposes two distinct terms (see e.g. Møller-Nielsen 2016: 67)? As a matter of fact, we have a very easy solution, which effectively bypasses this worry. For us, the weak discernibility of the spheres is not a result of a difference in relation. Rather, the difference in relation, and hence the distinctness, is a result of two distinct locational kind universals. Arguably, the resulting distinctness is not in fact mere weak discernibility, but we wish to only insist on weak discernibility in light of the built-in epistemic limitations of the account. We contend that this is enough to settle the metaphysical issue even if not the epistemic one.

[17] We should again mention that we don't take the case to be closed even with regard to bosons; on the prospects of discerning elementary particles, see for instance Muller and Seevinck (2009).

[18] For a recent summary of the debate concerning weak discernibility, see Ladyman (2015); Møller-Nielsen (2016); Saunders (2003) is the classic text.

VI. CONCLUSION

We have argued that a bundle theory with substantial kind universals constitutes an alternative well worth consideration. There is some independent motivation for substantial kind universals: they can act as truthmakers for laws of nature and unify the essential properties of basic natural kinds. Our theory does not involve commitment to objects as a separate category, which means that it is at least on a par with Paul's sophisticated bundle theory in terms of qualitative ontological economy. Indeed, we have argued that the resulting theory is more parsimonious than competing bundle theories because we are not committed to a primitive universal/particular distinction and because the commitment to substantial kind universals can also be motivated through their use in additional metaphysical explanations. As with more standard bundle theories, the symmetric universe of two iron spheres forms a *prima facie* difficulty for our account. However, we believe that it is a reasonable compromise to consider 'the distinct spheres' as (at least) weakly, metaphysically discernible.

ACKNOWLEDGEMENT

REFERENCES

Armstrong, D. M. (1997) *A World of States of Affairs*. Cambridge: CUP.
—— (1978) *A Theory of Universals*. Cambridge: CUP.
Benocci, M. (2018) 'The Repeatability Argument and the Non-Extensional Bundle Theory', *Australasian Journal of Philosophy*, 96: 432–46.
Curtis, B. (2014) 'The Rumble in the Bundle', *Noûs*, 48: 298–313.
Campbell, K. (1990) *Abstract Particulars*. Oxford: Basil Blackwell Ltd.
Ehring, D. (2002) 'Spatial Relations Between Universals', *Australasian Journal of Philosophy*, 80: 17–23.
—— (2011) *Tropes*. Oxford: OUP.
Fine, K. (2000) 'A Counter-Example to Locke's Thesis', *Monist*, 83: 357–61.
Gilmore, C. S. (2003) 'In Defence of Spatially Related Universals', *Australasian Journal of Philosophy*, 81: 420–8.
—— (2014) 'Location and Mereology', in E. N. Zalta (ed.) *The Stanford Encyclopedia of Philosophy* (Fall 2014 Edition), ⟨http://plato.stanford.edu/archives/fall2014/entries/location-mereology/⟩.

Hawley, K. (2001) *How Things Persist*. Oxford: OUP.
—— (2006) 'Weak Discernibility', *Analysis*, 66: 300–3.
Hawley, K. and Bird, A. (2011) 'What are Natural Kinds?', *Philosophical Perspectives 25: Metaphysics*, 205–21.
Hommen, D. (2019) 'Kinds as Universals: A Neo-Aristotelian Approach', *Erkenn*, published online, doi: 10.1007/s10670-019-00105-6.
Keinänen, M. and Hakkarainen, J. (2014) 'The Problem of Trope Individuation: A Reply to Lowe', *Erkenn*, 79: 65–79.
Keinänen, M., Keskinen, A. and Hakkarainen, J. (2017) 'Quantity Tropes and Internal Relations', *Erkenn*, published online, doi: 10.1007/s10670-017-9969-0.
Ladyman, J. (2015) 'Are There Individuals in Physics, and if so What Are They?' In A. Guay and T. Pradeu (eds.), *Individuals Across the Sciences*, 193–206. Oxford: OUP.
Lewis, D. (1986) 'Against Structural Universals', *Australasian Journal of Philosophy*, 64: 25–46.
Lowe, E. J. (1998) *The Possibility of Metaphysics*. Oxford: OUP.
—— (2006) *The Four-Category Ontology*. Oxford: Clarendon Press.
—— (2009) *More Kinds of Being*. Oxford: Wiley-Blackwell.
—— (2012) 'A Neo-Aristotelian Substance Ontology: Neither Relational nor Constituent', in T. E. Tahko (ed.), *Contemporary Aristotelian Metaphysics*, 229–48. Cambridge: CUP.
—— (2015) 'In Defence of Substantial Universals', in G. Galluzzo and M. J. Loux (eds.), *The Problem of Universals in Contemporary Philosophy*, 65–84. Cambridge: CUP.
Morganti, M. (2011) 'Bundles, Individuation and Indiscernibility', *European Journal of Analytic Philosophy*, 7: 36–48.
Muller, F. A. and Seevinck, M. P. (2009) 'Discerning Elementary Particles', *Philosophy of Science*, 76: 179–200.
Møller-Nielsen, T. (2016) 'Weak Discernibility, Again', *Ergo*, 3.
Nolan, D. (2011) 'Categories and Ontological Dependence', *The Monist*, 94, 277–301.
O'Leary-Hawthorne, J. (1995) 'The Bundle Theory of Substance and the Identity of Indiscernibles', *Analysis* 55: 191–6.
O'Leary-Hawthorne, J. and Cover, J. A. (1998) 'A World of Universals', *Philosophical Studies* 91: 205–19.
Pashby, T. (2016) 'How Do Things Persist? Location Relations in Physics and the Metaphysics of Persistence', *Dialectica*, 70: 269–309.
Paul, L. A. (2002) 'Logical Parts', *Noûs*, 36: 578–96.
—— (2006) 'Coincidence as Overlap', *Noûs*, 40: 623–59.
—— (2012) 'Building the world from its fundamental constituents', *Philos Stud*, 158: 221–56.
—— (2013) 'Categorical Priority and Categorical Collapse', *Aristot Soc Suppl Vol*, 87: 89–113.
—— (2017) 'A One Category Ontology', in J. A. Keller (ed.), *Being, Freedom, and Method: Themes from van Inwagen*, 32–61. Oxford: OUP.
Rodriguez-Pereyra, G. (2004) 'The Bundle Theory is Compatible with Distinct but Indiscernible Particulars', *Analysis* 64: 72–81.
Saunders, S. (2003) 'Physics and Leibniz's Principles', in K. Brading and E. Castellani (eds.), *Symmetries in Physics: Philosophical Reflections*, 289–307. Cambridge: CUP.
Sider, T. (2001) *Four Dimensionalism*. Oxford: Clarendon Press.
Simons, P. (1994) 'Particulars in Particular Clothing: Three Trope Theories of Substance', *Philosophy and Phenomenological Research*, 54: 553–75.
Simons, P. (2003) 'Tropes, Relational', *Conceptus*, 35: 53–73.
Thomasson, A. (2018) 'Categories', in E. N. Zalta (ed.) *The Stanford Encyclopedia of Philosophy* (Spring 2018 Edition), ⟨http://plato.stanford.edu/archives/spring2018/entries/categories/⟩.
Williams, D. C. (1953) 'On the Elements of Being', *The Review of Metaphysics*, VII: 3–18 & 171–92.
Zhang, R. (2018) 'A New Universal Bundle Theory', *Philosophia*, 46: 473–86.

[1] *Tampere University, Finland*

[2] *University of Bristol, UK*