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On Spacetime, Points, and Bare Particulars

Abstract

In his paper *Bare Particulars*, T. Sider claims that one of the most plausible candidates for bare particulars are spacetime points. The aim of this paper is to shed light on Sider's reasoning and its consequences. There are three concepts of spacetime points that allow their identification with bare particulars. One of them, Moderate structural realism, is considered to be the most adequate due its appropriate approach to spacetime metric and moderate view of mereological simples. However, it pushes the Substratum theory to dismiss primitive thisness as the only identity condition for bare particulars, but the paper argues that such elimination is a legitimate step.

Keywords: bare particulars, spacetime, the Substratum theory, identity

In his *Bare Particulars* (Sider 2006), T. Sider boldly claims that one of the most plausible candidates for bare particulars are spacetime points:

> *The substratum theorist should accept the actuality, not just the possibility, of truly bare particulars. I have in mind points of spacetime …. What are the distinctive intrinsic features of points of spacetime? If we look at science for guidance, we find that physical theories require almost nothing of the points intrinsically. I suggest, then, that a natural and economic theory of points of spacetime is that each one is a partless, truly*

bare particular that stands in a network of spatiotemporal relations (2006, 10).[1]

The aim of the paper is to shed light on Sider's proposal and see if it represents a real alternative to the Substratum theory (ST). If it represents such an alternative, then it must show that bare particulars are not mere extravagant metaphysical fictions (Lowe 2003, 88). Sider is not explicit about his scientific guide to spacetime ontology, and our task is to identify those spacetime models that seem to support the notion of a bare particular. Three candidates will be considered: Manifold substantivalism with primitive thisness, Manifold substantivalism with structuralist identity conditions, and Moderate structural realism. The candidates differ in many respects. Neither versions of Manifold substantivalism treat the metric adequately, in contrast to Moderate structural realism. Moreover, Manifold substantivalism with primitive thisness leads to a Humean picture of the world as a mosaic of independent and point-like entities, whereas the remaining alternatives avoid such a controversial view. According to this paper, Moderate structural realism is considered to be the best setting for spacetime points as bare particulars while the Manifold substantivalism with primitive thisness is the worst. However, primitive thisness is often associated with bare particulars, but the structuralist view pushes ST to dispense with it. Before looking at Sider's proposal in detail, we need to decide whether the elimination of primitive thisness is acceptable to ST. If it is, then bare spacetime points firmly show that bare particulars are not mere extravagant fictions and that they serve other useful purposes too (Lowe 2003, 88).

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[1] As Sider indicates, there is also an entirely different approach that conceives bare particulars as end-products of the conceptual separation of particulars and their properties (Tichý 1988, 211). According to this line of thought, bare particulars are not physically existing entities and thus a quest for their candidates is irrelevant. Bare particulars are only heuristic tools (e. g., to grasp the difference between essential and accidental properties), but this is denied in this paper. We assume that if there are bare particulars, then they must be – as real ontological entities – largely independent of our conceptual schemes.

Bare particulars reconsidered

In the current literature, bare particulars are not what they were originally supposed to be: entities with no natures and devoid of any properties. The current view is rather liberal: bare particulars do have properties and do have natures (Davis 2003, 236-37; Moreland 1998, 257-258; Sider 2006, 3-4). In addition to trivial properties such as 'being particular' and 'being bare', the liberal theories also admit non-trivial properties. Suppose that there are fusions of bare particulars. If there are such things, then they are composed of bare particulars instantiating or bearing polyadic properties, universals or tropes. Moreover, relations reflect the natures of their relata and these are just two cases that lead us to undermine traditional ST.

If I am right, the message of Sider's paper is this: ST specifies formal requirements that bare particulars satisfy but it doesn't provide us with specific examples of such entities. If it is not possible to give a specific example of a bare particular, then ST is indeed an extravagant fiction, but Sider's paper tries to prove the very opposite.[2] Firstly, ST commits bare substrata not to instantiate or bear *monadic* properties. More precisely, not to instantiate or bear *monadic* and *intrinsic* properties. The distinction between intrinsic and extrinsic is a complex one but we will follow some rather simple-minded views which, I believe, are sufficient for our purposes. To paraphrase D. Lewis, a thing has its intrinsic properties in virtue of the way that thing itself is, whereas extrinsic properties may depend on something else (Lewis 1983, 111-12). For that reason, the property of 'being taller then John' is monadic but not intrinsic because it involves two things: owner of the property and John. In contrast, having a mass is both monadic and intrinsic because, in a possible world in which there is nothing but you, you still have the mass. One of the assumptions of our simple-minded approach is that polyadic properties (or properties reducible to polyadic properties) are necessarily relational and thus extrinsic.[3] However, we will consider structuralist identity conditions and they show that

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[2] It often happens in metaphysics that theories specify criteria of certain entities but it is beyond their scope to identify examples. The competence is often in the hands of science and our case of bare particulars and spacetime points is exactly that situation.

[3] This distinction is also labeled as the distinction between pure and impure properties in the literature.

the distinction between monadic/intrinsic and relational/extrinsic may not work. The problem is that the identity of a particular is determined, according to structuralists, by the relations in which it stands, and this might lead us to conclude that relational properties are, on the structuralist rock bottom, intrinsic properties of their bearers. However, my view is that relations are always extrinsic but, within the relationist setting, they have some flavor of intrinsicallity, but only in the sense that they are identity-defining elements. In fact, structuralism requires us to separate identity from intrinsicallity because, within this framework, identity coincides with extrinsicallity.

Identity and individuation will be frequently discussed topics in this paper. If what has been said about ST is true, then it is misleading to attach any particular identity conditions directly to ST because individuation of bare particulars largely depends on what is supposed to be a bare particular. ST, as such, is neutral in this regard. T. Sider considers two candidates for bare substrata, spacetime points being one of them. Spacetime points – as bare substrata – bring their specific individuation criteria to ST in order to individuate bare particulars properly. [4] This is also the reason why it is misleading to regard, for instance, primitive thisness as the only possible identity condition for bare particulars. It may be that the majority of substratum theorists do assume primitive thisness, but there is also another option related to spacetime points: structural identity conditions. Moreover, there is a conceptual reason that makes primitive thisness external and independent of ST. The expression 'primitive thisness' is often used as a synonym for expressions such as 'individual essence', '*heacceity*' or 'Leibnizian essence'. There might be some subtle differences between *heacceities*, individual and Leibnizian essences, but all of them assume that individuators of particulars are universals (e.g., 'being identical with itself'), not bare particulars. [5] Despite sharing

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[4] This explains why one of 'the most serious' charges against ST is irrelevant. It is claimed that bare particulars are particulars but not individuals (because they are indistinguishable) and, as far as the individuation is concerned, ST fails. It is irrelevant because ST provides individuation criteria only after it is supplemented by a specific set of bare particulars with strict identity conditions of their own.

[5] As Lowe comments, bare particulars are obviously particulars whereas *heacceities* (and individual and Leibnizian essences - M.S.) are universals, although unsharable ones (Lowe 2003, 88). The distinction

certain similarities, ST and the theories presupposing primitive thisness refer to ontologically distinct categories, and this is often overlooked by both defenders and critics of ST.

If spacetime points are bare particulars, then ST commits them to be devoid of intrinsic monadic properties and, according to its modern versions (Moreland 1998, 257), of internal constitution. We will see how some spacetime models approach these requirements.

Manifold substantivalisms

Manifold substantivalism (MS) was proposed by J. Earman (1989, 11). Earman identifies spacetime's structure with the manifold of differentiable points. The manifold is endowed with differential and topological properties but points, as such, are intrinsically bare: there is no intrinsic monadic universal they instantiate nor any intrinsic monadic trope they bear. This makes spacetime points ideal candidates for bare particulars. However, Earman's proposal is rather inadequate because it undermines the role of metric. Since spacetime is identified with the manifold, metrical field and metrical relations are extrinsic to it. The manifold functions as a substratum - or geometrical ether (Meschini and Lehto 2006, 1206) - which supports physical fields including the metrical, with the provision that the metrical field is a different sort of field from other physical fields. This leads MS to a clear-cut separation of spacetime (as an ethereal container) and physical fields (as its fillers). However, this is questionable:

> *While, on the one hand, the metric field carries the distinction between spatial and temporal directions, allows measures of spatiotemporal distances, and specifies the inertial motions (as geometric entities typically do), on the other it also carries energy and momentum, satisfies differential equations, and acts upon matter, as physical fields do. The*

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between individuating universals and bare particulars can also be found in Davis's exposition of bare particulars (Davis 2003, 536) and in Adam's distinction between thisness and suchness (Adams 1979, 6).

former roles leads us to claim that the metric field g_{ab} should be spacetime; the latter roles push us in the opposite direction, namely are conducive to maintain that it is the bare manifold that should represent spacetime, since the metric field is also, and indisputably, a physical entity. In reality, the tensor field g_{ab} has both roles, and I take it that this is the main, essential message of GTR (General Theory of Relativity – M.S.) (Dorato 2006, §3).[6]

In a word, the metric field is the very segment that links spacetime with its occupants and this is ignored by MS.[7] There is yet another reason why MS is not a good choice for substratum theorists. The function of spacetime points is a physical task of localizing fields. Points are intrinsic to the very concept of the physical field (Meschini, Lehto 2006, 1206). But how are the points individuated?

There are two options for MS in relation to identity conditions of spacetime points (Golosz 2005, 88-90). The first option is primitive thisness, but it turns points into individual essences of particulars and not into their substrata. The second option is a structural identity condition based on the roles and relations between particular spacetime points within the differential and topological structures they compose. However, these identity-defining structures don't include, according to MS, the metric, and this is considered as a serious default. If the metric is included, then we are leaving MS and, as will be proposed, heading to Moderate structural realism, which is considered to be the most plausible framework of spacetime points as bare particulars in this paper.

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[6] As will be argued at the end of the paper, our proposal directly accommodates this message because it considers spacetime as an essential ingredient of particulars.

[7] There is an alternative to MS within the substantivalist camp. The alternative is metrical essentialism (Maudlin 1989, 86-8). It treats the metric fairly but at the cost substratum theorists are not willing to pay. Metrical properties are, according to metrical essentialism, intrinsic properties of spacetime points, but this contradicts the notion of a bare particular.

Moderate structural realism

The roots of Moderate structural realism (MSR) are in an epistemological claim that scientific theories don't reveal fundamental intrinsic properties of physical objects but only their causal relations with our senses or measuring instruments (Esfeld and Lam 2006, 2). However, MSR goes further and claims that there is nothing to be revealed because there are only relations in which physical objects stand but no fundamental intrinsic properties they bear (Esfeld and Lam 2006, 2). The same applies to spacetime points:

> *... metrical properties of spacetime ... give us nothing more then extrinsic properties of spacetime points: they tell us what the spatiotemporal relations between points are but they can tell us nothing about one isolated point of spacetime* (Golosz 2005, 87).

And, again, the reason is that MSR, as a metaphysical thesis, does away with fundamental intrinsic properties (Esfeld and Lam 2006, 7). So far so good, because spacetime points don't instantiate or bear intrinsic monadic properties, only polyadic properties grounded in their relations and roles within the spacetime structure. Intrinsic monadic properties are avoided, and this qualifies spacetime points to be bare particulars. However, MSR theorists would probably object to this claim because, as it seems, they associate bare particulars with primitive thisness.[8] If it was true that the identity condition of a bare particular is necessarily primitive thisness, then bare particulars must be rejected by MSR because MSR rejects primitive thisness. But this is not true and, as a result, MSR is not committed to reject bare particulars unless we prove that bare particulars resist structuralist identity conditions. However, one of the main assumptions of this paper is the very opposite: structuralist identity conditions are also applicable to bare

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[8] To be more precise, this is how M. Esfeld and J. Golosz replied to my proposal of identifying bare particulars with spacetime points within the framework of MSR.

particulars (identified with spacetime points). Esfeld and Lam reveal MSR's approach to identity in the following way:

> ... the identity of space-time points is completely determined by the space-time (chronogeometrical, inertio-gravitational, causal) relations they exhibit, that is, their 'position' in the (generally covariant) network of space-time relations (2006, 12).

However, the structuralist is rather free to choose which spacetime relations or networks count as identity-defining but metrical relations are generally considered indispensable:

> ... metric tensor field completely determines the structural identity of the space-time points: these latter do not posses any physical intrinsic properties over and above the metric relations that the metric tensor field attributes to them (Esfeld and Lam 2006, 11). [9]

These features of structuralist identity conditions perfectly satisfy the formal requirement of ST not to appeal to intrinsic monadic properties when defining identity conditions of bare particulars. It leads us to assume that, in the line of MSR, spacetime points are bare particulars but with structuralist identity conditions.

    To conclude, there are three ontological models of spacetime points which lead to spacetime points as intrinsically bare particulars: MS with primitive thisness, MS with structuralist identity conditions, and MSR. According to this paper, MSR should be preferred because the remaining alternatives undermine the role of the metric. Moreover, there is another reason to reject the first alternative and it concerns its radical Humean heritage.

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[9] In addition to metrical, topological and differential structures, Golosz also considers affine connections as plausible individuators of spacetime points (2005, 92-93).

Ontology of mereological simples

Bare particulars don't instantiate or bear any intrinsic monadic properties, but particulars normally do. The ontological picture of a particular, according to ST, is twofold: bare substratum and properties it instantiates (in the case of monadic universals) or bears (in the case of monadic tropes). However, such monadic universals or tropes are intrinsic properties of a particular, not of its substratum (Lowe 2003, 85).

If Sider's proposal is correct, then properties of particulars are, in Lowe's words (Lowe 2003, 85), supported by spacetime points. But what are such particulars like? Their substrata (spacetime points) are mereological simples that lack any intrinsic constitution. Can Sider's proposal go beyond simples? There is straightforward reasoning supporting the negative answer:

1) extended entities require, according to ST, extended substrata
2) extension of spacetime points (as substrata) leads to spacetime regions
3) spacetime regions are not bare because they are endowed with metrical, topological and differential properties as their *intrinsic* properties (in contrast with bare points)

The conclusion is that any extension of particulars whose substrata are spacetime points is impossible. Composition is not permitted because it turns substrata, bare spacetime points, to spacetime regions, which are not intrinsically devoid of properties.

However, Sider doesn't give up the possibility of extended particulars and offers the following support.[10] The metrical properties of regions are their intrinsic properties, but they are polyadic, grounded in the metrical relations of their constituents, bare spacetime points. And this is the way out of the ontology of mereological simples: intrinsic monadic properties are avoided because metrical properties are always polyadic and thus extrinsic. This harmonizes regions with bare particulars. However, there are several problems in this argument, and Sider admits two of them. (1) If structural

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[10] It was suggested to me in an e-mail exchange with T. Sider.

properties are assumed, then a region of spacetime (as a whole) instantiates a structural metrical property that is its intrinsic and monadic property, and this contradicts the idea of an intrinsically bare particular. (2) Sider's reasoning doesn't touch differential and topological properties, which are necessarily intrinsic and monadic properties of spacetime regions regardless whether structural properties are assumed or not. (3) Sider's argument undermines the distinction between intrinsic/monadic and extrinsic/relational because, in the case of spacetime regions, metrical properties are relational and, at the same time, intrinsic. However, we don't need to reconsider the distinction because (1) and (2) alone make Sider's escape from the ontology of point-like entities doubtful.[11]

In a word, an attempt to extend bare spacetime points to regions leads to a loss of bare substrata. As a consequence, defenders of MS (of both versions) and MSR are committed to a point-like ontology or, as J. Butterfield calls it (2006, 8), to *pointillisme.* However, there is a difference between MS and MSR in this regard. According to MS with primitive thisness, the world is a Humean mosaic of point-like and independent entities. MS with structural identity conditions (based on the topological and differential structures) and MSR (with identity conditions based on the topological, differential and metrical structures) imply pointillistic ontology but with some holistic features. According to these two alternatives, spacetime is composed of points whose external relations are constitutive elements of their identity. The identity of a particular spacetime point is given by its role within the whole spacetime structure. This is denied by Humeans and defenders of MS with primitive thisness, who consider points to be independent of each other because their identities are set prior to any relations in which they stand or can stand.[12]

Objections

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[11] For Sider, as a defender of ontological composition, an ontology of mereological simples must be avoided but I can't see how he manages to do so in the realm of spacetime points.

[12] As a matter of fact, the holistic features make Butterfield's arguments against pointillisme formulated in (Butterfield 2006) irrelevant to bare substrata with structuralist identity conditions.

Three objections to bare substrata with structuralist identity conditions can be anticipated.

1. Symmetric relations

Spacetime points can stand in identical spatiotemporal relations and therefore perform exactly the same roles within the spatiotemporal structure. As a consequence, they are indistinguishable because their individuators (extrinsic relations) are identical. To paraphrase Golosz's comment, structural theories supply us with identity conditions of spacetime points, but they are not strict enough (2005, 89) because symmetric worlds are their limit. We will not respond to this issue here and leave it to structural realists. Let me only state, without an argument, that any theory of identity and individuation has its limits, and if they are exceeded, the theory fails because it can't perform its role. I don't want to claim that there are no good or bad theories of individuation. I only believe that individuation is largely a theory-dependant issue, and that structural theories pushed their limits of identification far enough to be treated as a serious option.

2. Underdetermination

Underdetermination is a real problem. There are two distinct ontological pictures attachable to spacetime points within the frameworks of MSR and MS with structuralist identity conditions. Spacetime points in extrinsic relations can be conceived as intrinsically bare (this is our choice) or they can be directly identified with the fusions of those extrinsic relations (Dorato 2006, 3). The later option leads to the bundle view of spacetime points: there is no need to postulate bare particulars in extrinsic relations if extrinsic relations themselves can be the only ontological ingredients of particulars. However, this doesn't mean that the Bundle theory is a problem-free solution, but the final verdict, which one is the better one (spacetime points as bare particulars with structuralist identity conditions or spacetime points as bundles of relations) would require an account of its own.

3. Hybrid particulars[13]

Sider's proposal might be considered unintuitive because spacetime (via its points) becomes one of the ontological constituents of particulars. Put in a different way, we conceived (point-like) particulars as fusions of spacetime occupants and their locations (spacetime points). Despite contradicting everyday intuition that separates spacetime and its occupants, hybrid particulars directly respond to The General theory of relativity, which assumes that matter and spacetime are two sides of the same coin. [14] This is the reason why we can, via hybrid particulars, easily explain some striking similarities between mereological and geometrical features of traditional particulars and their locations. [15]

It must be admitted that hybrid particulars, with spacetime points as their substrata, lead to rather revisionary metaphysics. They commit us to reconsider several fundamental notions and intuitions (identity, motion, persistence, propositions about particulars and their locations, etc.). However, these revisions are generated in a process of fitting old with new: the Substratum theory with some contemporary views of spacetime. I believe that these revisions are improvements of ST, which show that bare substrata and the Substratum theory itself are not mere episodes in the history of metaphysics.

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[13] I borrowed the adjective 'hybrid' from B. Skow (2007, 11).

[14] There are several, but mostly negative and sketchy, accounts of hybrid particulars in the literature, e. g. J. Parsons (2007, 26-30) and B. Skow (2007, 11).

[15] As far as I know, only supersubstantivalism can compete with hybrid particulars in this regard. However, supersubstantivalism reduces particulars directly to chunks of spacetime and this is a high price for any ontology of particulars, including ST, because supersubstantivalism makes particulars superfluous.

I am in debt to M. Esfeld, J. Golosz and T. Sider for their e-mail replies that helped me to clarify the approach of Moderate structural realism to bare particulars (Esfeld and Golosz) and expose some details of the proposal to identify spacetime points with bare particulars (Sider).

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