A Trope Theoretical Analysis of Relational Inherence

MARKKU KEINÄNEN

1. Introduction

Trope bundle theories of substance (e.g. Williams 1953; Campbell 1990; Maurin 2002; Keinänen 2011, Keinänen & Hakkarainen 2010, 2014; Giberman 2014) aim to construct objects and all other entities by means of aggregates of tropes. Tropes are thin particular natures like a particular *–e* charge or a particular roundness in some location. Thus, tropes are themselves concrete in the sense of having some specific spatial or spatio-temporal location. In trope theories, objects and all other particulars are constructed as mereological sums of tropes that fulfil certain conditions. For instance, objects are identified with mereological sums of mutually co-located ("concurrent" or "compresent") tropes (cf. Williams 1953; Campbell 1990). The thin nature of a trope is contrasted with the thick nature of the object constituted by distinct tropes.[1]

It has been customary to consider tropes as *particularized qualities* or *particular properties of objects* (cf. Armstrong 1989, Allen 2016). The standard ways to pick out and identify tropes as properties of objects (like the redness of some rose) have provided support to this intuitive conception.[2] Nevertheless, being a particular property is a primitive category feature of

[1] In Williams' and Campbell's classical trope theories, tropes are also considered as "abstract" in the sense of having capability of being co-located with other tropes, Fisher (2018, sec.1).

[2] As does Lowe (2003), we have distinguished between individuation in the epistemic sense (i.e., picking out an entity in our thought) and individuation in the metaphysical sense. (i.e., the determination of the identity conditions of an entity). Moreover, we defend the idea that tropes have primitive identity conditions, Keinänen & Hakkarainen (2014).

modes, which primitively inhere in (or, characterize) objects.[3] By contrast, most trope theories (i.e. trope bundle theories) aspire to *analyze* monadic inherence (objects having tropes), e.g., by means of parthood, co-location and/or existential dependencies.[4] Therefore, being a property (or, being an object) is not left primitive.

The trope theoretical analysis of monadic inherence can be regarded as a case of *metaphysical reduction*: in the analysis of inherence, a central feature of reality (objects having properties) is reduced to the holding of a fact about the basic entities of the category system (tropes). In the basic level, there are assumed to be only tropes that form objects if the respective aggregate of tropes fulfils certain conditions.[5] Correspondingly, the object has a trope as its property if and only if it has the trope as a certain kind of part. We may take a trope theory that identifies objects with mereological sums of co-located tropes as a simple example. Assume that object i is a mereological sum of three mutually co-located tropes t_1, t_2 and t_3, which are determinate quantities. Let t_1 be a determinate –e charge, t_2 a determinate mass, and t_3 a determinate spin quantum number. Object i has trope t_1 as its property (i.e., i has a –e charge) if and only if i has trope t_1 as its part and t_1 is co-located with i. Thus, in the trope theoretical analysis of inherence, the reduction is assumed to take place in the general level of ontological categories: the facts about objects and properties are assumed to be identified with the facts about tropes and the complex entities tropes form.

In trope theories, the "traditional" object-property dichotomy is explained away. Neither of these two categories – *objects* (entities characterized by properties) or *properties* (entities

---

3 Modes are introduced by the different substance attribute theorists in a two category ontology of substances and modes (cf. Martin 1980; Heil 2012), or in Neo-Aristotelian four-category (Lowe 2006, 2009, 2015) and six-category (Ellis 2001) ontologies.

4 For instance, classical trope theories (Williams 1953, Campbell 1990) analyze monadic inherence in terms of parthood and co-location: trope t is a property of object i if and only if t is a part of i and t is co-located with i.

5 According to Williams (1953) and Campbell (1990), tropes are existentially independent entities and objects are mereological sums of co-located (compresent, concurrent) tropes. Cf. Keinänen (2011, sec. 3) and Fisher (2018) for further discussion.

inhering in or characterizing objects) – retains its status as a basic category. Fundamentally, tropes are neither properties nor objects. Although tropes are conveniently identified (or picked out) as "properties of their bearers" (like e charge of a positron or redness of a rose), they are particular natures – entities of a single fundamental category – which constitute all (or almost all) other entities.

Nevertheless, the trope theoretical analysis of inherence remains silent about relations or relational entities. Dealing with the question about the existence and ontological status of relations has turned out to be difficult for trope theorists. Most trope theorists have recently held either of the two main alternative views about relations, which, as I will argue, are both unsatisfactory. The first is the *eliminativist* view adopted by Keith Campbell (1990) and Peter Simons (2014, 2016), according to which there are no relations or relational entities. Everything that exists is constituted by monadic tropes. Tropes are connected by different kinds of internal relations, but internal relations are not relational entities additional to their relata.[6] Secondly, the advocates of the *relata specific v*iew - Anna-Sofia Maurin (2002, 2010, 2011), Jan-Willem Wieland and Arianna Betti (Wieland & Betti 2008; Betti 2015) - introduce relational tropes in addition to monadic tropes.[7] The existence of relational trope *r* is assumed to entail that *r* relates (or, relationally inheres in) certain specific relata *a* and *b*.

As I will argue in section 2, the relata specific view is unsatisfactory because it re-introduces the primitive dichotomy between characterizing (relations) and characterized entities (objects) at the level of relations. According to the relata-specific view, there are both primitively relating (relational tropes) and primitively related entities (objects). The relata-specific view leaves *relational inherence* as a primitive formal ontological relation between relational tropes and their relata. Thus, a trope theorist adopting the relata specific view loses one of the

---

[6] For different kinds of internal relations, cf. Keinänen, Keskinen & Hakkarainen (2017, sec.2).

[7] Officially, Wieland & Betti (2008) and Betti (2015) stay neutral between tropes and modes. Moreover, they allow for the possibility of relata specific relation universals. However, they work out their position by considering the relata specific entities as tropes.

main benefits of trope theories, which is the general analysis of inherence. In order to retain the initial attraction of trope theories, eliminativism might seem to be an appealing option. In section 3, I argue that eliminativism sets serious limitations to the ontological explanatory power of trope theories. In addition to spatio-temporal relations, the current scientific theories have introduced entities which are serious candidates for entities to be best categorized as relations or relation-like existents.

Therefore, the main objective of section 4 is to present a new trope theoretical analysis of relational inherence. The aim is to offer a metaphysical reduction of relational inherence, that trope *r* relates two or more entities. In other words, I reduce the holding of relational inherence to the obtaining of certain other relations in the trope theoretical category system. The analysis generalizes the trope theoretical analysis of inherence provided by the Strong Nuclear theory (SNT) (Keinänen 2011; Keinänen & Hakkarainen 2010, 2014) to relation-like tropes, r-tropes, for short. Section 5 deals with asymmetric and non-symmetric relations, which are a prima facie difficult case for the analysis, by assuming that all fundamental relations are quantities. Finally, in section 6, I provide a completely new account of the location of r-tropes.

2. The relata specific view

Anna-Sofia Maurin (2002, 2010, 2011), Jan-Willem Wieland & Arianna Betti (2008) and Betti (2015) have recently made an important contribution to trope ontology by defending relational tropes.[8] According to their view, relational tropes are primitively relating and relata specific entities. Assume that trope *r* is a relata-specific relational trope of 1 m distance between two objects *a* and *b.* Although there are minor differences in the different formulations of the relata specific view, a relata specific relational trope *r* is assumed to fulfil the following three conditions:

[8] However, Betti (2015, 100ff.) considers her defense of the relata specific view conditional: if we must introduce relations at all, the relata specific view constitutes the best account of relations.

1. Necessarily, if relational trope *r* exists, its relata, *a* and *b*, also exist. To put this in formal ontological terms, trope *r* is multiply rigidly dependent (only) on its relata, *a* and *b*.[9]

2. Necessarily, if trope *r* exists, *r* relates (i.e., relationally inheres in) *some* relata.

3. Necessarily, if trope *r* exists, *r* relates (relationally inheres in) its specific relata, *a* and *b*.

Thus, according to the relata specific view of relational tropes (henceforth, *the relata specific view*), necessarily, if trope *r* exists, objects *a* and *b* are in a 1 m distance from each other. In other words, the sole existence of a relational trope is considered to entail that certain relational fact obtains.

The relata specific relational tropes are introduced in order to avoid the *modal version of Bradley's regress*, in which the condition that starts the regress is formulated in modal terms. Assume that relational trope of 1 m distance *r* and its relata *a* and *b* exist. The general worry in this version of Bradley's regress is that, *prima facie*, the existence of an external relation and its relata does not entail that the relation relates its relata. The postulation of additional relations – such as the relation of instantiation connecting the relation and its relata – would only transfer the problem to a higher level (Wieland & Betti 2008; Maurin 2010, 2011). Relational tropes seem to solve the regress problem because the existence of certain relational trope *r* already entails that the relation between specific objects holds. For instance, the existence of 1 m distance trope *r* entails that objects *a* and *b* are in 1 m distance from each other. Because the existence of *a* and *b* does not entail the existence of *r*, the distance relation is contingent and external to its relata, objects *a* and *b* (Wieland & Betti 2008, sec.3).

Returning to what the relata specific view entails, conditions 1-3 are not independent of each other. It is fairly easy to

---

9 Let "≤ " be a relation of improper parthood between entities and "E!" the predicate of (singular) existence. "SRD (e,f)" = e is strongly rigidly dependent on f. The multiple rigid dependence of t on f and g, "MRD (t, (f, g)", can be presented as follows: MRD (t, (f, g)) = □(E!t → (E!f ∧ E!g ∧ ¬(f ≤ t) ∧ ¬(g ≤ t) ∧ ¬(f ≤ g) ∧ ¬(g ≤ f))) ∧ ¬ (□ E!f) ∧ ¬ (□ E!g) ∧ ¬ (SRD(f, g)) ∧ ¬ (SRD (g, f)).

observe that if relational trope *r* fulfils condition 3, it also satisfies the two first conditions. Trivially, if trope *r* relates certain specific relata, trope *r* relates some relata (3 entails 2). Moreover, the holding of a relation between specific relata entails that the relata exist. Therefore, assuming that *r* is a relata specific relational trope – that the existence of *r* is sufficient to its relating objects *a* and *b* – entails that *r* is also multiply rigidly dependent on *a* and *b* (3 entails 1). However, the converse does not hold (1 does not entail 3): multiple rigid dependence of trope *s* on two entities *a* and *b* does not entail that *s* relates these two entities.[10]

The last-mentioned point requires some discussion because there has been confusion about the role of multiple rigid dependence in the metaphysical explanation of relata specificity. Multiple rigid dependence (MRD, for short) is a *formal ontological relation* that connects mereologically disjoint contingent existents. MRD spells out how its relata can exist as the constituents of the world. However, the constraints MRD sets on its relata are minimal: necessarily, if entity *s* exists (somewhere, somewhen), then its dependees *a* and *b* also exist (somewhere, somewhen). In addition to holding between a relational trope and its relata, MRD can hold between events and the specific objects involved in these events or between borders and the objects confined by these borders, for instance. In order to distinguish between different kinds of entities which are multiply rigidly dependent on some other entities (e.g., between borders and relational tropes), we are obliged to provide a more detailed description of their category features.

According to the relata specific view, it is a primitive category feature of relational tropes that they relationally inhere in (i.e., relate) certain specific relata. In other words, *specific relational inherence* is not analyzed further and it is supposed to be a primitive formal ontological relation connecting its relata.[11]

---

[10] As MacBride (2011, 173) observes, "[n]ecessary coexistence of a relation and its terms is not enough to ensure that the relation holds between its terms". To be more exact, the holding of 1 does not guarantee that *r* is a relational trope and that 3 holds.

[11] The most explicit advocates of the relata specific view, Wieland & Betti (2008) do not directly characterize specific relational inherence ("relating specific entities") as a formal ontological relation. However, they assume it

Specific relational inherence fixes the categorial nature of relational tropes as a specific kind of relational accident (e.g., in contradistinction to borders and events). This formal ontological relation spells out what general kind of entities relational tropes are and how they can exist as constituents of the world.[12] The primitive relational inherence is comparable to the formal relation of characterization ("monadic inherence") between modes (particular properties) and objects E.J. Lowe (2006, 2009, 2015) introduces in his Four-Category Ontology (cf. Keinänen 2018, sec.3). Like characterization, specific relational inherence is considered to be an internal relation: necessarily, if given entities occurring in specific relational inherence (a relational trope and its relata) exist, specific relational inherence holds between its relata. The advocates of the relata specific view claim to avoid Bradley's relation regress by assuming that the existence of the entities connected by specific relational inherence is sufficient to the holding of specific relational inherence.[13]

The relata specific view faces three serious difficulties. The first is that the relata specific view introduces particular relations (i.e. relational tropes) as a primitive ontological category. In other words, it introduces a distinction between primitively relating and primitively related entities. This distinction is parallel to the primitive distinction between modes and objects (particular attributes and substances).[14] One of the central motivations of trope theory is to eliminate the substance attribute distinction by means of the analysis of inherence (cf. Campbell 1990, secs. 1.1-1.6). If trope theorists must re-introduce a parallel distinction in the case of relational tropes, this seriously reduces the attraction of trope theories.

Moreover, there are two more specific problems, which are closely connected to the first. The first of these problems is a

---

to be a part of the nature of relational tropes (as entities belonging to a certain category) that they relate certain specific relata (ibid, sec. 3).

[12] Cf. Hakkarainen & Keinänen (2017) and Hakkarainen (2018) for more on formal ontological relations.

[13] By using our terminology (cf. Keinänen, Keskinen & Hakkarainen 2017, sec. 2), specific relational inherence is assumed to be a *basic internal relation* between its relata.

[14] Particular properties or modes are recently advocated, e.g., by Lowe (2006, 2009, 2015), Ellis (2001) and Heil (2012).

consequence of the fact that specific relational inherence entails multiple rigid dependence, but the converse does not hold. One can ask: can we find an analysis for relational inherence by means of multiple rigid dependence and some additional condition? Like the analysis of monadic inherence, such an analysis would reduce the number of the primitive formal ontological relations needed in trope theory. Moreover, one could bring much-needed clarity to the category system by analyzing relational inherence by means of more transparent primitive notions (such as parthood and rigid dependence). Since the relata specific view leaves relational inherence as a primitive formal ontological relation, the opportunity for a further trope theoretical clarification of the category system is lost in the case of relational inherence.

The third problem concerns the spatial or spatio-temporal location of relational tropes. Most trope theorists are inclined to adopt the ontological view that all entities are spatio-temporal particulars, which Peter Simons (2010, 207; 2016, 113) calls "naturalistic nominalism". Thus, let us assume that also relational tropes have a spatio-temporal (or, at least a temporal) location. Assume that *r* is a 1 m distance trope relating objects *a* and *b*. Trope *r* is determining the location of other entities, but it is difficult to determine the location of *r* (cf. Simons 2003, sec.2). The advocates of relational tropes have not provided any answer to this difficulty. This is unsatisfactory because relational inherence seems to entail restrictions to the location of relational tropes – for instance, that relational tropes are at least temporally co-located with their relata. Since we are unaware of the exact consequences of relational inherence, this casts doubt on using relational inherence as a basic notion of an ontological category system.

3. Eliminativism

According to eliminativism (Campbell (1990; Simons 2014, 2016), there are no relations – relational tropes or any other kind of relational entities. Thus, relations (or, relational tropes) are eliminated as a fundamental category.[15] The world is constituted by monadic tropes, which are particular natures.

---

[15] Earlier, Simons (2003, 2010) postulated entities he called "relational tropes". Nevertheless, Simons' "relational tropes" are relational accidents,

Because of the serious problems of the relata specific view, the adoption of eliminativism with respect to relations might seem to be an attractive option for trope theorists.[16] Nevertheless, I will argue in this section that eliminativism is, if not provably false, at least a very risky position for two main reasons. The first is that eliminativism seriously restricts the available options in providing a trope theoretical account of space/space-time. Secondly, eliminativism seems to block natural ways to categorize many entities introduced in scientific theories as relations or relation-like beings.

Considering first the metaphysics of space/space-time, spatio-temporal relations are widely considered as external relations between objects. In other words, their holding is contingent relative to the existence of their relata. Since eliminativists deny the existence of relations, they would be obliged to consider (contingent) spatio-temporal relations *derived internal relations*, internal relations that hold due to the holding of the internal relations between entities some of which are distinct from the relata of the original relation (Keinänen, Keskinen & Hakkarainen 2017, sec. 2). For instance, having the same mass as between objects *a* and *b* is a derived internal relation, which holds because of *a* and *b* having equal ("exactly similar") mass tropes as their certain kinds of parts. Similarly, the spatial distance between objects *a* and *b* might be contingent relative to the existence of *a* and *b* if there are certain additional, mutually internally related entities also internally related to both *a* and *b*.

Most of the recent eliminativist views about relations have been committed to a *substantivalist theory of space/space-time* (a *substantivalist view* for short): the claim that space-time points, regions of space-time or space-time itself are primitive object-like entities.[17] The general idea of these eliminativist accounts

---

entities multiply rigidly dependent on two or more entities. He does not bestow them with any additional category features. Therefore, Simons' earlier account of relational tropes is seriously incomplete (cf. note 10).

[16] Certain advocates of primitive substances, such as Heil (2012, 2016) and Lowe (2016), have also proposed strategies to avoid the postulation of relations.

17 Lowe's (2016) otherwise interesting account is a case in point. Mulligan (1996) avoids commitment to ("thick") spatio-temporal relations by assum-

is that the spatio-temporally related entities stand in some internal relations (such as identity or monadic inherence) to (the parts of) the space-time structure. The contingency of spatio-temporal relations is either explained by means of the contingent existence of the space-time structure or simply denied. Since trope theories strive to eliminate objects (in the sense of bearers of properties or relations) as a primitive category, a trope theorist adopting a substantivalist view would be obliged to construct space/space-time by means of tropes. No clear idea of such construction has been presented so far. Substantivalist theories of space/space-time typically allow for the existence of empty space-time points. No substantivalist trope theorist has managed to show that empty space-time points can be constructed by means of tropes.

Thus, an *anti-substantivalist* or a *relationalist theory of space/space-time* might seem to be a preferable view for the trope theorist.[18] Peter Simons (2016) has proposed a construction of space-time by means of internal relations among the fundamental concrete entities. This view is better characterized as an anti-substantivalist than a relationalist account of space-time because it does not introduce any relations or other relational entities. Instead, Simons assumes that fundamental entities are *occurrents* (i.e., processes and events) having their spatio-temporal locations necessarily. All standard continuants (or, endurants) are *Fregean abstractions* from occurrents.[19] Moreover, he assumes a causal theory of time.

Simons' general claim that all fundamental particulars are occurrents is contestable and his examples of the construction

---

ing space-time points, which have tropes as their individual accidents. Although being a trope theorist, Campbell is also inclined to adopt a substantivalist theory of space-time. In his Abstract Particulars (1990), Campbell rejects his earlier (Campbell 1981) identification of tropes with "formed volumes", i.e., parts or regions of space/space-time. In his final, scientifically inspired version of trope theory, Campbell takes space-time as a single simple entity, and all other entities are fields in the same space-time manifold (1990, 145ff.).

18 All theories of space/space-time that deny the existence space/space-time or its parts as a separate substance(s) are anti-substantivalist.

19 Cf. Simons (2000, 2008) for a proposal to construct continuant objects as Fregean abstractions from occurrents.

of continuants from occurrents have remained schematic.[20] Even if all fundamental entities were occurrents, we would need additional reasons to support the claim that occurrents have their specific locations necessarily. It might be tempting to *individuate* processes and events by their spatio-temporal location, but it is not clear whether such intuitions about individuation are applicable to a process ontology like the one suggested by Simons.[21] It seems to be a safer alternative for a trope theorist to adopt a relationalist theory of space/spacetime, which takes (some of the) spatio-temporal relations as relational entities. One can reconcile this full-blown relationalist theory of space/space-time with a more standard view that the same entities could have had different locations or relative positions. In other words, the spatial/spatio-temporal relations between entities are contingent relative to the existence of their relata.

Finally, the current science and the current quantum physics in particular provide trope theorists independent reasons to postulate relations or relation-like entities. The current quantum physics introduces entangled states of two- or multi-particle systems, which are serious candidates for fundamental relations between particles (cf. Teller 1986; Karakostas 2009). For instance, Paul Teller (1986, sec.4) has argued that entangled spin-states of two superposed electrons are best considered as relations, which do not supervene on the spatio-temporal arrangement and the monadic properties of these particles. In the context of trope theory, these entangled spin-states would be good candidates for relational tropes (cf. Keinänen 2011, 434). Additionally, a trope theorist may need to introduce relational tropes to account for the "emergent" features of complex objects, that is, the features of complex objects which do not supervene on the properties of their proper parts.[22] Finally, the present-day quantum physics introduces

---

[20] For instance, Simons' (2000) examples of constructed continuants are complex objects. Nevertheless, it remains unclear whether we would need continuant objects not reducible to occurrents as proper parts of complex objects.

[21] Cf. MacBride (2016, ch.2) for a brief criticism of Simons' eliminativism.

[22] One possible example of such emergent properties are masses of complex physical particles like helium atoms, which cannot be directly reduced to the masses of their proper parts. I have suggested elsewhere that such

virtual particles (such as photons and gluons) to account for interactions between micro-particles (electrons, quarks). It is an interesting, a hitherto unstudied option to consider such interactions relational tropes.

Even this limited set of examples shows that there is reasonable work for relational tropes in an a posteriori orientated trope theory. Most importantly, relational tropes (or tropes which would function like relational tropes) would bestow trope theory with the required ontological explanatory power to respond to the challenge of the different, currently popular relational ontologies. Given the serious difficulties the relata-specific relational tropes face, the trope theorist is advised to seek for a reductive analysis of relational inherence.

4. The analysis of relational inherence

The basic idea in the reductive analysis of relational inherence is to generalize the trope theoretical analysis of monadic inherence to "relational tropes". In the analysis of relational inherence, the general goal is to provide a metaphysical reduction of relational inherence: to identify the facts about two or more entities being connected by a relation with the facts about the entities of the trope theoretical category system. Since relational inherence is explained away, also relational tropes (i.e. primitively relating entities) are eliminated from trope theory. However, certain tropes, which I call "*r-tropes*", take the role of relational entities in the present account. The main difference between standard "property tropes" and r-tropes is their standing in slightly different kinds of formal ontological relations and being parts of different kinds of complex entities. Nevertheless, there is no such thing as a primitive category distinction between primitively characterizing entities (properties), on the one hand, and primitively relating entities (relations), on the other.[23]

---

emergent properties are best categorized as relational tropes, cf. Keinänen (2011, 447).

[23] The entities belonging to the same category bear the same formal ontological relations to themselves and to certain other entities. These formal ontological relations are internal relations – necessarily, if certain entities

Hence, the reductive analysis will have two main goals: the first is to eliminate the *primitive* distinction between relational tropes and their relata, which threatens to set serious limitations to the ontological explanatory power of trope theories. The second goal is to incorporate the relation-like entities, which are capable of serving the core functions set to relations in an a posteriori basis, into the trope theoretical framework. My goal will not be to deal with all conceivable cases of relations. In order for the reductive analysis of relational inherence to serve its purpose, it suffices to consider credible a posteriori examples of relational entities and submit their relational inherence to reductive analysis.

Recall that the different trope bundle theories analyze *monadic inherence* in different ways. For the present purposes, it suffices to consider two trope theories. Campbell's (1990) theory takes objects as mereological sums of mutually co-located ("compresent") tropes. Correspondingly, trope *t* inheres in object *i* if and only if *t* is a part of *i* and *t* is co-located with *i*.[24]

By contrast, in the trope theory SNT (Keinänen 2011; Keinänen & Hakkarainen 2010, 2014), tropes are assumed to be mutually existentially dependent beings and objects are constituted as aggregates of tropes connected by the formal ontological relations of rigid and generic dependence.[25] Here, I confine myself to outlining the features of the SNT directly relevant to the present discussion.[26] According to the SNT, every object has either a single nuclear trope or, alternatively, two or more tropes rigidly dependent on each other, the *nuclear*

---

exist, it is a primitive fact about them that certain formal ontological relations hold, cf. Hakkarainen (2018) for this kind of account of ontological categories.

[24] Since Campbell (1990, secs.4.3-4.4) constructs complex quantity tropes as "conjunctive compresences" of simpler tropes falling under the same determinable, an additional maximality condition would be needed to be added to the analysis in order to deal with such mutually co-located tropes forming a complex trope.

[25] Let "≤ " be a relation of improper parthood and "E!" the predicate of (singular) existence. Entity *e* is strongly rigidly dependent on entity *f*, if the following condition holds: ¬(□ E!f) & □ ((E!e → E!f) & ¬(f ≤ e)), cf. Simons (1987, 112, 294ff.).

[26] Cf. Keinänen (2011, sec. 4) for a more systematic presentation of the SNT.

tropes.[27] Nuclear tropes are necessary parts of an object *i* and, intuitively, constitute its "necessary properties". Trope *t* is a part of object *i* if and only if *t* is rigidly dependent only on the nuclear tropes of *i*. Object *i* is a *dependence closure* of tropes with respect to rigid dependence.[28] Because object *i* is a dependence closure of tropes, *i* is not rigidly dependent on any entity which not its proper part.[29]

Unlike Campbell's trope theory, the SNT does not build objects by means of co-location ("compresence") but uses the relations of existential dependence.[30] The second major difference between these two trope theories concerns the determination of the location of individual tropes. In Campbell's trope theory, individual tropes are relata of the basic spatio-temporal relations, whereas in the SNT, this function is given to certain trope bundles. According to the SNT, the certain kinds of aggregates of tropes (e.g. the nuclear tropes of a substance) form individuals, which are minimal relata of the basic spatio-temporal relations. The spatio-temporal locations of these complex entities determine the locations of their constituent tropes. In a simple case, object *i* is constituted solely by its nuclear tropes and the location of *i* determines the location of the tropes that are its proper parts. The SNT analyzes monadic inherence in this special case as follows: trope *t* is a property of

---

[27] According to the SNT, trope *t* is a nuclear trope if and only if 1) *t* is not rigidly dependent on any other trope (a single nuclear trope), or 2) *t* is rigidly dependent on certain trope(s) which are also rigidly dependent on *t* (two or more nuclear tropes).

[28] A dependence closure of tropes with respect to rigid dependence is a plurality of tropes in which all rigid dependencies of the tropes in the plurality are fulfilled. Moreover, we assume that necessarily, if these tropes exist, they form an individual. As a consequence, that individual is not rigidly dependent on any mereologically disjoint entity, cf. Keinänen (2011, 446-447).

[29] The applicability of the notion of rigid dependence is restricted to contingent existents cf. note 25. Moreover, as advocates of naturalistic nominalism (cf. section 3), trope theorists can reject the existence of sets, on which objects would (allegedly) be rigidly dependent.

[30] Here, I offer only a simplified sketch of the construction of objects in the SNT.

object *i* if and only if, necessarily, if *t* exists, *t* is a proper part of *i* and *t* is co-located with *i* [31]

In what follows, my strategy is to generalize the analysis of monadic inherence of the trope theory SNT to *r-tropes*. Moreover, the analysis will adopt one of the main assumptions of the relata specific answer, namely, that r-tropes are multiply rigidly dependent (MRD, for short) on two or more entities. Since multiple rigid dependence is not sufficient to relational inherence, we need to specify additional conditions that hold of trope *r* and objects *a* and *b* if *r* relationally inheres in *a* and *b*. Rigid dependence will be supplemented by the condition of necessary co-location as we will see below. Although the analysis of relational inherence is based on the idea that r-tropes are dependent existents, it is purported to be consistent with considering tropes other than r-tropes existentially independent as Williams (1953) and Campbell (1990) do.

Thus, r-tropes are *multiply rigidly dependent* (MRD) on two or more entities. Assume, for instance, that r-trope *r* is a 1 m distance trope connecting entities *a* and *b*: *a* and *b* are in a 1 m distance from each other. Trope *r* is MRD on *a* and *b*. This multiple rigid dependence involves three things. First, necessarily, if distance trope *r* exists, entities *a* and *b* (its "relata") also exist. Second, entities *a* and *b* are mereologically disjoint and mereologically disjoint from *r*. In other words, r-tropes connect mutually "wholly distinct" (mereologically disjoint) entities and are wholly distinct from the entities which they connect, their "relata". Third, entities *a* and *b* are not rigidly dependent on each other. The third condition rules out the cases in which trope *r* is rigidly dependent on the nuclear tropes of a single object. Finally, in order to rule out trivial cases (e.g., in which the dependees *a* or *b* are necessary existents), it is presupposed in the characterization of MRD that trope *r* and entities *a* and *b* are all contingent existents.[32]

---

[31] Keinänen (2011, 438-440). The more general condition, which also deals with the tropes contingent to an object, is temporally qualified: necessarily, trope *t* is co-located with *i* when it exists (ibid. 440ff.).

[32] The characterization of rigid dependence and multiple rigid dependence are thus restricted to contingent existents, cf. Simons (1987, 294ff.) for a similar restriction.

The crucial step in the analysis is to add three more conditions in order to obtain the conclusion that trope *r* relates, that is, relationally inheres in *a* and *b*. The first two conditions concern the constitution of an r-complex. The first is that *a* and *b* are the only entities on which trope *r* is rigidly dependent, *r* is rigidly dependent only on *a* and *b*. Secondly, trope *r* together with its dependees ("relata"), *a* and *b*, form an individual, which I call an "*r-complex rab*".[33] R-complex *rab* is a dependence closure of its proper parts with respect to rigid dependence. As a dependence closure of its parts, r-complex *rab* is itself a strongly rigidly independent entity, it is not rigidly dependent on any entity that is mereologically disjoint from *rab*. Hence, r-complexes are substances in the weak sense of being *strongly independent particulars and individuals*.

The third condition is that r-complex *rab* is a spatio-temporally located entity: r-complex *rab* has a spatio-temporal location and its location determines the location of its constituent r-trope, 1 m distance trope *r*. Like the objects constituted by their nuclear tropes, an r-complex is a strongly independent particular and has all of its proper parts necessarily. Moreover, as in the case of objects having only nuclear tropes, the location of the r-complex determines the location of its existentially dependent part, r-trope *r*. As we will see below, some, but not all, r-complexes are entities that figure in the basic spatio-temporal relations and have an independent location in this sense. Again, they are like objects constituted by nuclear tropes. On the basis of these assumptions, I now propose the following analysis of the holding of relational inherence:

[RI]:
Trope *r* relationally inheres in *a* and *b* if and only if:
1. *r* is multiply rigidly dependent (MRD) on *a* and *b*, but not rigidly dependent on any entity that is not a part of *a* or a part of *b*.
2. *a* and *b* are not rigidly dependent on *r*.
3. *a* is not rigidly dependent on *b*, and *b* is not rigidly dependent on *a*.
4. *r*, *a* and *b* constitute an individual, r-complex *rab*.

---

[33] Note that every r-complex is an individual and a mereological sum of its parts (e.g., r + a + b = s).

5. Necessarily, if *r* exists, *r* is exactly co-located with *rab*.

Let us take again 1 m distance trope *r* as an example. Trope *r* relates (relationally inheres in) *a* and *b*, if *r* is both multiply rigidly dependent on *a* and *b* and necessarily (exactly) co-located with r-complex *rab*, which is a mereological sum of all these three entities (i.e., r+a+b).[34]

The purpose of [RI] is to generalize the analysis of monadic inherence of the trope theory SNT to r-tropes, that is, the tropes that fulfil clauses 1-3 of [RI]. This generalization is achieved by assuming that the corresponding r-complex, whose existence is entailed by the existence of *r*, is an individual having a specific spatio-temporal location. Moreover, like the location of an individual constituted by mutually rigidly dependent tropes (nuclear tropes), the location of the r-complex determines the location of its existentially dependent parts (an r-trope in this special case). Thus, necessarily, if r-trope *r* exists, it is co-located with *rab*. As a consequence, trope *r* fulfills the conditions of monadic inherence in relation to complex *rab*: necessarily, if *r* exists, *r* is a (proper) part of *rab* and *r* is co-located with *rab*. Thus, *r* is a monadic property of complex *rab*. According to [RI], by being a monadic property of r-complex *rab*, trope *r* also relationally inheres in *a* and *b*.

In order to motivate this analysis of relational inherence, it is useful to begin with the idea of tropes as particular natures (-e charges, 1 m lengths, etc.). According to the analyses of monadic inherence discussed above, tropes are monadic properties of an individual because they are mutually co-located parts of that individual, which might also need to fulfil some additional conditions (as in the SNT). R-tropes, like 1 m distance trope *r*, are particular natures co-located with the corresponding r-complexes and monadic properties of these r-complexes. Furthermore, r-trope *r* is a certain kind of entity that connects mutually distinct entities, *a* and *b*, into a certain kind of more inclusive whole. In order to see this, we need to observe three things. First, trope *r* and complex *rab* are (weakly) rigidly dependent on *a* and *b*. Thus, second, given

[34] In what follows, I leave out the qualification, although I refer to exact co-location when talking about "co-location".

that trope *r* exists, *a* and *b* are parts of a certain kind of r-complex, *rab*. Third, since *a* and *b* are proper parts of complex *rab,* their locations are parts of the location of *rab*.[35] Consequently, locations of *a* and *b* are parts of the location of trope *r*.

Hence, according to [RI], tropes relate (relationally inhere in) their relata by being properties of the respective r-complexes ("relational complexes"), which have their relata as proper parts. In the special case discussed just above, trope *r* (1 m distance trope *r*) relates entities *a* and *b* in a certain way because *r* "makes" *a* and *b* as parts of a certain kind of complex individual, 1 m distance r-complex *rab*.

5. Asymmetric and non-symmetric relations

An obvious worry with [RI] concerns *asymmetric* and *non-symmetric* relations. Causal relations, relations of spatial direction (such as being to the left of) and temporal direction (being after than) are salient examples of asymmetric relations. Many relations between quantitative properties (such as being greater than or equal to), some spatial relations (facing) and relations manifesting human attitudes (admiring, loving) are *non-symmetric* without being asymmetric. Prima facie, asymmetric and non-symmetric relations hold between entities in a certain order (cf. Fine 2000, 1). For instance, Muodoslompolo is to north of Tornio but Tornio is not to north of Muodoslompolo (asymmetry); Young Werther loves Charlotte, but Charlotte does not love Werther (non-symmetry). It seems that [RI] is not able to deal with non-symmetric or asymmetric relations because r-tropes do not themselves bestow any order on the parts of r-complexes. Therefore, it seems that clause [RI] can only provide us with an account of the special cases of relational inherence in which the relation under consideration is *symmetric* (e.g., the relational tropes of spatial distance if there are such entities). As a consequence, if we accept the proposed analysis, we seem to be obliged to deny the existence of all asymmetric and non-symmetric relations. This is an untenable conclusion if we take seriously the examples of relations the empirical science gives us (cf. MacBride 2014, sec.1, 2016, sec. 4).

---

[35] As Parsons (2007, 213) argues, all concrete entities satisfy the following principle of Expansivity: the spatial location of a whole is as least as inclusive as the spatial location of its proper parts.

Nevertheless, some of the above examples are *basic* or *derived internal relations*, which do not exist as separate relational entities. Rather, tropes and complex entities they constitute are internally related in different ways.[36] In section 3, I already mentioned derived internal relations. Having a greater mass than or having a smaller charge than are examples of asymmetric *derived internal relations*, which hold between objects having certain kinds of mass or charge tropes as their parts. Moreover, the quantity tropes falling under a determinable (e.g. electric charge) are mutually connected by the different basic internal relations of proportion (e.g., 1:1 proportion or -3:1 proportion) and the basic internal relation of order (greater than or equal to). These basic internal relations hold because tropes are certain thin particular natures - the existence of the related entities is a sufficient condition for their obtaining. Moreover, the holding of these relations does not depend, even indirectly, on the existence of any specific entities distinct from their original relata (Keinänen; Keskinen & Hakkarainen 2017, sec.3). Here, the relation of order is non-symmetric, whereas the relations of proportion are symmetric or asymmetric.

Formal ontological relations constitute additional examples of basic or derived internal relations.[37] For instance, tropes are proper parts of objects, which is an asymmetric formal ontological relation. Moreover, in the SNT, all tropes constituting an object are connected by the non-symmetric formal ontological relation of rigid dependence. Asymmetric and non-symmetric basic or derived internal relations do not cause any problem for the present analysis: because they are not relational entities, internal relations do not relationally inhere in anything. Rather, it is a primitive fact about quantity tropes that they are ordered, that e charge tropes are greater than e/3 charge tropes, for instance. Similarly, it is a primitive fact about tropes that they are rigidly dependent on certain distinct tropes.

---

[36] Cf. Keinänen; Keskinen & Hakkarainen (2017, sec.2) for a more precise characterization of the distinction between basic and derived internal relations.

[37] Cf. Hakkarainen & Keinänen (2017) for the distinction between formal ontological relations, which are "nature neutral", and other basic internal relations.

Moreover, I adopt a sparse theory of relational entities, which is in line with a sparse theory of tropes (Campbell 1990, sec. 1.8): there are only few different kinds of relational entities, which are all discovered empirically. An advocate of a sparse theory of relational entities can remain skeptical of the existence of any such macro-level relational entities as the relational tropes of love or macroscopic causation (Simons 2003; Lowe 2016, 106-110). The best prima facie candidates for r-tropes are basic (or, comparatively basic) physical quantities. Among them, there are asymmetric vector quantities like momentum and asymmetric quantitative spatial and temporal relations.

Assuming that all r-tropes are quantities, we can present a general strategy to deal with their asymmetry. In this account, we need not assume that inherence of r-tropes is asymmetric. In order to take a simple example, consider distances in some direction in a one-dimensional space.[38] Assuming that there are distance-direction tropes, they are vector quantities, magnitudes with a certain direction. In predicate logic, the direction of an asymmetric relation is typically indicated by argument places. Thus, for instance, object *a* is 1 m to the left of object *b*, Lab. Sentence "Lba" can be used to indicate that *b* is 1 m to the left of *a*. Hence, a relational predicate applies to a pair of objects in different ways depending on the direction of the corresponding relation.

It is important to keep in mind that r-tropes do not have any formal-ontologically specified direction. First, r-tropes do not have any argument places, by means of which the relata are put into some order. Second, the source of the order of the relata cannot be the different ways in which an r-trope is multiply rigidly dependent on certain entities. There is only one and a unique way in which an r-trope is multiply rigidly dependent on certain entities.

Nevertheless, the r-tropes of distance-direction are, as particular natures, determinate magnitude-directions (vectors). Like all quantity tropes falling under a determinable, the r-tropes of distance-direction are mutually connected by the dif-

[38] Of course, space-time intervals have replaced distances as basic quantities in the current physical theories of space-time. Therefore, I present this example of distance direction tropes only as an illustration.

ferent basic internal relations of positive or negative proportion (like, say 1:1 proportion or -3:1 proportion) and the basic internal relation of order (greater than or equal to). The choice of the unit for distance-direction is a matter of convention as well as which of these r-tropes of distance-direction get positive and which negative values. By contrast, because of being determined by the distance-direction tropes, the relations of proportion and order between distance-direction tropes remain invariant in all choices of the unit.[39]

Whether two r-tropes of distance-direction are connected by a relation of positive or negative proportion spells out their relative directions. The r-tropes connected by some relation of negative proportion are distance-directions to opposite directions, whereas the distance-direction r-tropes to the same direction are connected by some relation of positive proportion. Thus, according to the present approach, the direction is already included in a distance-direction trope as a particular nature. Similarly, an r-complex having a distance-direction trope as a proper part has an intrinsic direction determined by the respective r-trope, which may be opposite to the direction of another r-complex.

Hence, the present approach denies that r-tropes have any formal-ontologically determined (absolute or relative) direction. Unlike the recent views in the metaphysics of relations (e.g., positionalism or anti-positionalism), the present approach does not introduce any general (logical or formal-ontological) devices to determine the relative direction of argument places (cf. Fine 2000, secs. 3-4; MacBride 2014). Instead, the direction of a relational fact is determined by an r-trope as a particular nature.[40] The present approach does not over-generate directionality because the non-directional r-tropes falling un-

[39] Cf. Keinänen; Keskinen & Hakkarainen (2017, sec.3) for a defense of the same general account of internal relations between quantity tropes falling under a determinable.

[40] Certain r-tropes have an absolute direction as vectors. However, the direction of an r-trope is based on its nature and it does not correspond to any fixed order of the relata figuring as arguments of a relation. Similarly, there is no fixed way to indicate this direction by means of the order of the argument places of a two-place predicate, for instance.

der a determinable (e.g., distance tropes if there are such entities) are related only by the relation of order and the relations of positive proportion.

The above kind of quantitative r-tropes are good prima facie candidates for truthmakers of asymmetric predications such as "a is 1 m to the left of b" or "b is 1 m to the right of a". According to the present conception, these two sentences have the same truthmaker (i.e., some r-complex *rab*), but they correspond to the different ways in which the positive/negative unit of distance-direction can be selected.

Nevertheless, the best current candidates for the basic spatio-temporal r-tropes are particular space-time intervals. They are mutually connected by the different relations of positive, negative or zero proportion. However, space-time intervals do not have any intrinsic direction. Rather, the different kinds of intervals between objects in space-time points indicate, for instance, whether or not these space-time points can be involved in one temporally continuous succession of events. Thus, we are entitled to expect that asymmetric predications like "a is before b" or "a causes b" do not have r-tropes as their sole truthmakers, but, rather, more complicated structures of entities, which may involve some r-tropes.[41]

6. The location of r-tropes

According to clause [RI], an r-complex is an individual possessing certain spatial or spatio-temporal location, which determines the location of the corresponding r-trope. An advocate of the present analysis of relational inherence is obliged to provide some account of the determination of the location of r-complexes. Providing an answer to this question is particularly important in the case of r-complexes partially constituted by spatial or spatio-temporal r-tropes. There is a threat of a regress of spatial or spatio-temporal r-tropes if we need to postulate additional r-tropes to account for the location of every such r-complex.

The second issue concerns the peculiar character of spatial r-tropes. As we saw above, spatial r-tropes are assumed to be

---

[41] For instance, the claims about temporal precedence of events might be made true by complicated physical facts involving the increase of total entropy in universe.

distances or distance-directions between the different occupants of space. We need no recourse to relational inherence in the formal-ontological characterization of the r-complexes partially constituted by the spatial r-tropes. Nevertheless, since spatial r-tropes are assumed to be distances *between* objects, one might claim that being a relation is smuggled into the (non-formal) nature of r-tropes.[42] In what follows, I deal with these two issues concerning the spatial or spatio-temporal r-tropes and the respective r-complexes first. Finally, I address the determination of the location of r-complexes constituted by means of other kinds of r-tropes.

The current metaphysical discussion of space-time is, in large part, still dominated by the rivalry between substantivalist and relationalist theories about space-time.[43] According to the contemporary substantivalists, space-time is an independently existing entity of its own, which is constituted by space-time points having certain inertial features like curvature (Teller 1991, 363-4, 379). Relationalism (or, "liberalized relationalism" as Teller calls it) introduces spatio-temporal relations between actual objects and actual and possible objects. One is supposed to obtain the empty space-time points as locations of possible objects. Moreover, one is supposed to be able to construct the whole space-time manifold (the system of space-time points) by means of spatio-temporal relations (*ibid*).

From the point of view of trope theory, both of substantivalism and relationalism about space-time are problematic views. In section 3, I already mentioned the difficulty of constructing empty space-time points by means of tropes. A related problem can be addressed to liberalized relationalism: it is reasonable to demand that relations can connect only entities that exist. Thus, relationalism is prima facie committed to the existence of possible but non-actual objects. The merely possible objects are needed as relata of spatio-temporal relations. It is difficult to present any account of the construction of merely possible objects from tropes, which are actual and spatio-temporal entities. As a consequence, liberalized relationalism seems to be an equally unacceptable conception of space-time

---

[42] I am grateful to Jani Hakkarainen for presenting this problem.

[43] For additional alternative accounts of space-time, cf. e.g., Pooley (2005).

for a trope theorist as substantivalism, with which it is supposed to compete.

Without solving the problem of empty space-time points here, I adopt a broadly relationalist conception of space-time. According to it, r-tropes, which correspond to spatio-temporal relations, and the respective r-complexes *constitute* space-time (space might be used in illustrations). In other words, space-time is not considered as a separate object. Rather, space-time is a structure (wholly or partially) constituted by the mutually connected r-complexes. Although there are open issues in this type of view (like the status of empty space-time points if there are such items), it seems to provide us with a promising starting point for the construction of space-time from tropes.

For purposes of illustration, let us consider space and spatial relations between objects (distances or distance-directions). Consider now a single r-complex *rab*, which is a part of space, that is, the r-complex which has trope *r* (certain particular distance or distance-direction), and objects *a* and *b* as its parts. We can identify r-trope *r* with the shortest path of space connecting *a* and *b*. Trope *r* is a particular nature, a certain length in space. By being rigidly dependent on *a* and *b* and co-located with the respective r-complex, trope *r* can exist only in presence of the contents of space (space-time).

The location of r-complex *rab* is determined holistically, by its place in the system of spatial r-complexes. Assume that all other r-complexes than *rab* exist, among them the r-complexes that overlap *rab* by having *a* or *b* as their parts. If these other r-complexes exist, there must also be an r-complex connecting *a* and *b*. In other words, there must be an r-complex which has the same position in the network of r-complexes as *rab*. If *rab* exists, it has this specific position. Thus, the system of r-complexes determines the location of *rab* as a part of space.

It is possible to make additional assumptions, which constrain the nature of r-complex *rab* or any other r-complex having the same place in the system of r-complexes. In a special case of Euclidean space, the other existing r-complexes are parts of space and the spatial relations between *a* and other objects, and *b* and other objects are sufficient to necessitate the fact that *a* and *b* are connected by a r-trope (particular distance or distance-direction) of a certain determinate kind. However, the structure of space may have local variation, which allows

for *a* and *b* to be connected by different kinds of r-tropes. The identification of relational tropes with paths of space (space-time) solves the location problem of spatial (spatio-temporal) r-tropes: they are concrete entities that contribute to constituting space (space-time).

The second problem concerns the alleged primitive relatedness included in the nature of a spatial r-trope. In response, one can avoid primitive relatedness in the following way: objects *a* and *b* are parts of r-complex *rab*. Because of being proper parts of the distinct r-complexes, the locations of these objects, *a* and *b*, are proper parts of the locations of the distinct r-complexes. The r-complexes, which have an object as a proper part, assign to the object a determinate location as an intersection of the locations of these r-complexes. Therefore, we need not assume that an r-complex determines a primitive between-ness relation connecting objects *a* and *b*; rather, the system of r-complexes determines that objects *a* and *b* are in a certain distance (distance-direction) from each other.[44]

In the end of section 3, I provided some prima facie examples of relational entities such as entangled spin-states of multi-particle systems, emergent properties of complex objects and virtual particles. They are both good candidates for r-tropes and spatially located entities. It seems that the respective r-complexes are independently located entities and that their locations can be determined by spatial/spatio-temporal r-tropes. Of course, the specific details of such an account must be worked out in distinct cases.

7. Conclusion

Because of the reductive analysis of monadic inherence (objects having tropes), trope theories have promised to analyze away the primitive dichotomy between characterizing (properties) and characterized entities (objects). As I argued in section 2, the best trope theoretical account of relations, the relata specific view, re-introduces the same dichotomy at the level of relations. This is unsatisfactory and it reduces the initial appeal of trope theories. Nevertheless, we need relation-like entities

[44] One might claim that r-complexes self-locate (are their own locations). However, this not quite right because we need the whole system of r-complexes for an r-complex to have a specific location.

in an adequate conception of the categorial structure of reality, which rules out eliminativism about relations (section 3).

Therefore, in section 4, I presented a novel trope theoretical analysis of relational inherence, which is a generalization of the analysis of monadic inherence provided by the trope theory SNT. The analysis provides us with a metaphysical reduction of relational inherence to the facts about the entities of the trope theoretical category system. The core feature of the analysis is to introduce multiply rigidly dependent tropes, which I call *r-tropes*. Like all tropes, r-tropes are particular natures with a specific location. If r-trope *r* is multiply rigidly dependent on objects *a* and *b*, entities *r*, *a* and *b* form a complex individual, r-complex *rab*. An r-complex is a concrete particular and the location of r-complex *rab* determines the location of *r*. R-trope *r* relationally inheres in entities *a* and *b* by unifying them into r-complex *rab* and by being co-located with *rab*. For instance, since 1 m distance trope *r* unifies objects *a* and *b* into complex *rab*, objects *a* and *b* are in 1 m distance from each other.

In section 5, I argued that the present analysis can deal with asymmetric and non-symmetric relations by assuming that all fundamental relations are quantities. Finally, section 6 delivers an account of the determination of the location of r-tropes also in the difficult case in which an r-trope contributes to determining the spatial or spatio-temporal location of objects.[45]

University of Tampere

References

Allen, S. (2016), *A Critical Introduction to Properties*, London, Bloomsbury.

Armstrong, D.M. (1989), *Universals – an Opinionated Introduction*, Boulder, Westview Press.

Betti, A. (2015), *Against Facts*, Cambridge Ma., MIT Press.

Campbell, K. K. (1981), "The Metaphysic of Abstract Particulars", *Midwest Studies in Philosophy* 6, 477-488.

---

[45] I wish to thank A.R.J. Fisher, Robert Garcia, Daniel Giberman, Jani Hakkarainen, Antti Keskinen, Anna-Sofia Maurin, Tommi Vehkavaara and two anonymous reviewers for helpful comments on the earlier drafts of this article. Moreover, I thank the participants of the Nordic Network of Metaphysics conference "Metaphysics of Properties". Finally, I thank Finnish Cultural Foundation for funding this research.

Campbell, K. K. (1990), *Abstract Particulars*, Oxford, Basil Blackwell.

Ellis, B. D. (2001), *Scientific Essentialism*, Cambridge, Cambridge University Press.

Fine, K. (2000), "Neutral Relations", *The Philosophical Review* 109(1), 1-33.

Fisher, A. R. J. (2018), "Instantiation in Trope Theory", *American Philosophical Quarterly* 55(2), 153-164.

Giberman, D. (2014), "Tropes in Space", *Philosophical Studies* 167(2), 453-472.

Hakkarainen, J. (2018), "Ontological Form and Moderate Categorial Realism", manuscript.

Hakkarainen, J. & Keinänen. M. (2017), "The Ontological Form of Tropes – Refuting Douglas Ehring's Main Argument Against Standard Trope Nominalism", *Philosophia* 45(2), 647-658.

Heil, J. (2012), *The Universe As We Find It*, Oxford, Oxford University Press.

Heil J (2016), "Causal Relations", in A. Marmodoro & D. Yates (eds.), *The Metaphysics of Relations*, Oxford, Oxford University Press, pp. 127-137.

Karakostas, V. (2009), "Humean Supervenience in the Light of Contemporary Science", *Metaphysica* 10(1), 1-26.

Keinänen, M. (2011), "Tropes – the Basic Constituents of Powerful Particulars?", *Dialectica* 65(3), 419-450.

Keinänen, M. (2018), "Instantiation and Characterization: Problems in Lowe's Four-Category Ontology", in Timothy Tambassi (ed.), *Studies in the Ontology of E.J. Lowe*, Neunkirchen-Seelscheid, Editiones Scholasticae, pp. 109-124.

Keinänen, M. & Hakkarainen, J. (2010), "Persistence of Simple Substances", *Metaphysica* 11(2), 119-135.

Keinänen, M. & Hakkarainen, J. (2014), "The Problem of Trope Individuation – A Reply to Lowe", *Erkenntnis* 79(1), 65-79.

Keinänen, M., Keskinen, A. & Hakkarainen, J. (2017), "Quantity Tropes and Internal Relations", *Erkenntnis*, published online.

Lowe, E. J. (2006), *The Four-Category Ontology*, Oxford, Oxford University Press.

Lowe, E. J. (2009), *More Kinds of Being*, Oxford, Wiley-Blackwell.

Lowe, E. J. (2015), "In Defence of Substantial Universals", in G. Galluzzo & M. J. Loux (eds.), *The Problem of Universals in Contemporary Philosophy*, Cambridge, Cambridge University Press, 65-84.

Lowe, E. J. (2016), "There are probably no relations", in A. Marmodoro & D. Yates (eds.), *The Metaphysics of Relations*, Oxford, Oxford University Press, pp. 100-112.

MacBride, F. (2011), "Relations and Truth-Making", *Proceedings of the Aristotelian Society* 111, 159–76.

MacBride, F. (2014), "How Involved You Want To Be In A Non-Symmetric Relationship", *Australasian Journal of Philosophy* 92, 1-16.

MacBride, F. (2016), "Relations", *The Stanford Encyclopedia of Philosophy* (Winter 2016 Edition), Edward N. Zalta (ed.), <https://plato.stanford.edu/archives/win2016/entries/relations/>.

Martin, C. B. (1980), "Substance Substantiated", *Australasian Journal of Philosophy* 58(1), 3-10.

Maurin, A-S. (2002), *If Tropes*, Dordrecht: Kluwer Academic Publishers.

Maurin, A-S. (2010), "Trope Theory and the Bradley's Regress", *Synthese* 175(3), 311-326.

Maurin, A-S. (2011), "An Argument for the Existence of Tropes", *Erkenntnis* 74(1), 69-79.

Mulligan, K. (1998), "Relations Through Thick and Thin", *Erkenntnis* 48 (2 & 3), 325-353.

Parsons, J. (2007), "Theories of Location", in D. W. Zimmerman (ed.), *Oxford Studies in Metaphysics*, vol. 3, pp. 201–232.

Pooley, O. (2005), "Points, particles, and structural realism", in Rickles, D., French, S. & Saatsi, J. (eds.), *The Structural Foundations of Quantum Gravity*, Oxford, Oxford University Press, pp. 83-120.

Simons, P. M. (1987), *Parts – a Study in Ontology*, Oxford, Clarendon Press.

Simons, P. M. (2000), "Continuants and Occurrents", *Proceedings of the Aristotelian Society, Supplementary Volume* 74, 59-75.

Simons, P. M. (2003), "Tropes, Relational", *Conceptus* 35, 53-73.

Simons, P. M. (2008), "The Thread of Persistence", in Kanzian, C. (ed.), *Persistence*, Frankfurt, Ontos Verlag, pp. 165-184.

Simons, P. M. (2010), "Relations and Truth-Making", *Proceedings of the Aristotelian Society, Supplementary Volumes 84, 199-213.*

Simons, P. M. (2014), "Relations and Idealism: On Some Arguments of Hochberg against Trope Nominalism", *Dialectica*, 68, 305–315.

Simons, P. M. (2016), "External Relations, Causal Coincidence, and Contingency", in A. Marmodoro & D. Yates (eds.), *The Metaphysics of Relations*, Oxford, Oxford University Press, pp. 113-126.

Teller, P. (1986), "Relational Holism and Quantum Mechanics", *British Journal for the Philosophy of Science* 43, 201-218.

Teller, P. (1991), "Substance, Relations, and Arguments about the Nature of Space-Time", *Philosophical Review* 100(3), 363-397.

Wieland, J. W. & Betti, A. (2008), "Relata-specific Relations: A Response to Vallicella", *Dialectica* 62(4), 509-524.

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