

Kind Instantiation and Kind Change - A Problem for Four-Category Ontology

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Abstract.

In Lowe's Four-Category Ontology, instantiation is a basic formal ontological relation between particulars (objects, modes) and their kinds (kinds, attributes). Therefore, instantiation must be considered as a metaphysically necessary relation, which also rules out the metaphysical possibility of kind change. Nevertheless, according to Lowe, objects obtain their identity conditions in a more general level than specific natural kinds, which allows for kind change. There also seems to be actual examples of kind change. The advocate of Four-Category Ontology is obliged to resolve the tension between these mutually incompatible claims. In this article, we argue that the only viable option for the advocate of Four-Category Ontology is to bite the bullet and stick to the necessity of each of the most specific natural kind to the object instantiating it. As a major drawback, the four-category ontologist does not have any credible means to allow for kind change or determination of the identity conditions in a more general level.

Keywords: metaphysics, universals, realism, Neo-Aristotelian, instantiation, E.J. Lowe

1. Introduction

E.J. Lowe (1998, 2006a, 2009, 2015) endorses a Neo-Aristotelian category system, *Four-*

Category Ontology, introducing two different categories of abstract universals, *kinds* and *attributes*, on the one hand, and two categories of particulars, *objects* and *modes*, on the other.¹ In Four-Category Ontology, particulars and universals are connected by the single *basic formal ontological relation* of instantiation. Necessarily, every object (or substance) (e.g., a particular horse, a carbon-14 atom) instantiates some kind (horse, carbon-14 atom) and every mode (redness of some rose) instantiates some attribute (the property of redness).

In the present article, we argue that taking instantiation between substances and kinds as a basic formal ontological relation rules out the metaphysical possibility of kind change, that is, that an object is first a member of some specific kind K (horse), and later becomes to be a member of a distinct kind K' (tiger) replacing K. Ruling out kind change has very problematic consequences for Four-Category Ontology. The gist of our argument is that, as a basic formal ontological relation, instantiation holds necessarily given the existence of its relata. Nevertheless, the possibility of kind change would render instantiation metaphysically contingent relative to the existence of its relata.

We will argue that the ruling out the metaphysical possibility of kind change leads to serious problems in the context of Four-Category Ontology for two main reasons. First, there are plausible actual examples of objects changing their specific natural kind. In these events, objects remain as members of some general kind, which seems to be sufficient for the individuation of an object through change. Second, Lowe (1998) provides a detailed conception of the a priori determination of the identity conditions of objects as members of the most specific categories. Lowe's account is essential for his theory of individuation and gives a principled conception of the determination of identity conditions of objects while allowing for the metaphysical possibility of kind change. Nevertheless, his account is incompatible with the view that instantiation holds metaphysically necessarily given the existence of its relata.

We will consider the two main alternative ways to resolve these difficulties, which

¹ For the sake of the argument, in this paper we follow the contemporary realist's way of drawing the distinction between universals and particulars. Universals can be instantiated, whereas particulars cannot have instances. See e.g. Lowe 2006a, 89.

respect the basic assumptions of Four-Category Ontology, that is, how the four general categories are characterized. The first is to assume that objects are, necessarily, instances of their specific natural kinds. Moreover, in this view, all kind changes are reinterpreted as substantial changes. The second strategy is to postulate only general natural kinds and reconstruct all kinds contingent to their instances as derived sub-sorts of these general kinds, the *sub-sortal strategy*. We will argue that the sub-sortal strategy fails because it undermines the main motivation for Lowe's Four-Category Ontology: to introduce sufficiently many natural kinds for the required explanatory work. The first strategy turns out to be the best remaining alternative. However, this is a cold comfort for the advocates of Four-Category Ontology for, by adopting this strategy, they are obliged to deny the possibility of kind change as well as any sophisticated account of the determination of the identity conditions of objects as members of some general kind.

The structure of this paper is as follows. In section 2, we discuss Lowe's mutually incompatible views of instantiation. Section 2.1 concentrates on Lowe's basic motivation to consider the instantiation of kinds by objects as metaphysically contingent relative to the existence of its relata. Section 2.2 deals with the main reasons for Lowe (and any advocate of Four-Category Ontology) to take instantiation metaphysically necessary as a basic formal ontological relation. In section 3, we examine the two possible strategies to resolve the conflict between the necessity of instantiation relative to the existence of its relata and the possibility of kind change. Our discussion begins with the alternative according to which all natural kinds are necessary to their instances (section 3.1). After that, we examine the alternative of considering natural kinds contingent to their instances as derivative sub-sorts of genuine natural kinds (section 3.2). Section 4 concludes the article.

2. Instantiation

Lowe (2006a, 25, 98-99) adopts the standard "Aristotelian" immanent realism about universals. According to immanent realism, there are universals but they depend for their

existence upon their particular instances. Thus, there cannot be uninstantiated universals: all universals must have at least some instances in order to exist. Moreover, Lowe divides the immanent realism into two types, *strong* and *weak*, depending on how we understand the immanence of universals “in” their particular instances (Lowe 2006a, 98-99). According to *strong immanent realism* (Lowe 1998, 156; cf. 2006a, 98-99), universals are literally in their concrete instances, hence themselves concrete (Armstrong 1989, 98-9, 1997; Smith 1997). On Lowe’s own *weak immanent realism* (WIR), universals are abstract, that is, non-spatio-temporal (Lowe 2006a, 99; cf. Bergmann 1967, 49; Ellis 2001, 73-76).

Lowe’s (1998, 2006a, 2009) Four-Category Ontology accommodates two categories of universals, *substantial kind universals* (“kinds” in Lowe’s terms) and *property universals* (“attributes”). According to Lowe’s Neo-Aristotelian account of universals, all universals are kinds: kinds of substances (kinds) such as *horse* or *water molecule* and kinds of modes (attributes) such as *redness* or the *mass of 1kg*. Officially, Lowe (2006a; 2009) restricts the use of the term “kind” to substantial kind universals, that is, kinds of objects. Unlike Ellis (2001), who is another recent Neo-Aristotelian holding a similar view about substantial and property universals, Lowe calls property kind universals (kinds of modes) “attributes”.

Lowe introduces two categories of particulars, individual substances or objects (such as a particular horse or a particular water molecule) and particular properties, that is, *modes*. Lowe considers particular properties objects’ ways of being. For instance, a red rose is characterized by a redness mode, a particular way the rose is. Modes are particular ways the objects are and, in many cases, dependent for their identity upon their bearers (objects).² Therefore, Lowe prefers the term “mode” to “trope” (Lowe 1998, 78; 2006a, 14-15).

Thus, Lowe introduces two categories of particulars that are connected to the universals in two different categories by *the same* basic formal ontological relation of *instantiation*.³ Moreover, according to Lowe, the basic formal ontological relation of

² However, some modes do not have determinate identity conditions (Lowe 1998, 79-83). They are only *essentially dependent* but not *identity dependent* on their bearers. Cf. Lowe (1998, sec.6) for the definitions of these different notions of dependence.

³ As a consequence, universals are generically dependent for their existence on their instances (particulars). According to Lowe (2006a, 37), this generic dependence (in his terms, non-rigid existential dependence) is

characterization, connects objects and their modes, on the one hand, and kinds and their attributes, on the other. Basic formal ontological relations are metaphysically non-reducible formal ontological relations - they cannot be reduced to other formal ontological relations.

In this article, we concentrate exclusively on instantiation. We argue in the present section that Lowe holds two mutually incompatible views about the modal character of instantiation. On the one hand, he maintains that, at least in many cases, objects instantiate their kinds contingently given the existence of objects and these kinds. He has strong systematic reasons to hold this view based on the distinction between identity conditions and sortal persistence conditions of objects. On the other hand, Lowe has even stronger reasons to claim that instantiation is a metaphysically necessary relation given the existence of its relata. This is the view that Lowe puts forth in his later articles (Lowe 2012, 2015). However, he never explicitly resolves the conflict between these two mutually incompatible views.

2.1 The possibility of kind change

According to Lowe, there are general metaphysical reasons to allow for the metaphysical contingency of the holding of the instantiation relation relative to the existence of its relata and the metaphysical possibility of kind change.⁴ As will be seen below, Lowe maintains that they are based on the fact that the most specific ontological categories (e.g., living organisms, stuffs and (perhaps) material objects) have distinct natural kinds as their sub-kinds. So, an object can persist and retain its most specific ontological category but change its natural kind.

Lowe (2006a, 38ff.) calls his category system *Four-Category Ontology* because it contains four general categories, namely, *substances*, *modes*, *attributes* and *kinds*. According to Lowe, these four categories divide into more specific sub-categories. However, the common feature of the members of the four general categories is their standing in exactly the same basic formal ontological relations (instantiation or characterisation) to some members

constituted by the formal relation of instantiation between universals and their instances.

⁴ Lowe 1998, ch. 8. In his later works, *The Four-Category Ontology* (2006a, 116) and *More Kinds of Being* (2009, 17), Lowe continues to maintain that there is a distinction between identity conditions and sortal persistence conditions of objects, the former being associated with the “highest kinds” of objects.

of the three other categories (Lowe 2006a, 39). For instance, kinds (such as *horse*) are instantiated by some individual substances (specific horses) and characterized by some attributes (such as warm-bloodedness).

The denizens of these four general categories divide into more specific categories. According to Lowe, this is based on the fact that the members of a general category differ in *their* (diachronic and synchronic) *identity conditions*. As does Lowe (1998, ch.8), we concentrate on more specific categories of substances. Since kinds are always “sub-kinds” of some specific category, they are kinds of substances of that category. In this way, category divisions among substances extend to the kinds which they instantiate.⁵ The (diachronic and synchronic) identity conditions, although given by the kind which the object instantiates, are provided to us as a part of our *a priori* knowledge of the most specific *category* to which the object belongs. As *prima facie* examples of the most specific categories, Lowe mentions *artefacts*, *living organisms* and *material stuffs* (*ibid*). According to him, our capability to think and talk about the object and its remaining as a certain kind of object (its sortal persistence conditions) already requires the *a priori* understanding of its identity conditions.

In contrast with the bare particulars theorists, Lowe does not consider the identity conditions of an object brute (or, based on its primitive haecceity). Rather, identity conditions are associated with *the fundamental general essence* of an object that determines the most specific category to which it belongs. For example, it is (part of) the fundamental general essence of Dobbin the horse that he is a living organism.⁶ Moreover, Lowe makes a distinction between the *sortal persistence conditions of objects*, on the one hand, and their *diachronic identity conditions*, on the other (Lowe 1998, 183-4; cf. 2009, 27). Whereas fundamental general essence of a substance (e.g. Dobbin) determines the latter, its sortal persistence conditions (the conditions in which Dobbin remains a horse) are determined by its

⁵ Although Lowe does not discuss this issue, certain kinds of modes like particular rednesses can *prima facie* characterize objects belonging to different categories (e.g., living organisms and material objects). Similarly, the universal attribute of redness may be possessed (in Lowe’s terms, exemplified) by objects belonging to different categories.

⁶ Lowe (2006b, sec.2) distinguishes between the *fundamental general essence* determining what is for an object to be a member of the category to which the object necessarily belongs (e.g., living organisms) and its *specific general essence*, which determines what is for an object to be a member of some natural kind (horse).

specific general essence (Lowe 2006b, sec. 2).

In order to understand the difference between identity conditions and sortal persistence conditions, let us illustrate it with a tiger. As a tiger and a living organism, a tiger instantiates the *natural kind* tiger and belongs to the most specific *category* of living organisms.⁷ The natural kind tiger provides the sortal persistence conditions for the tiger: under which conditions she persists as a tiger (as an instance of this natural kind). Instead, the diachronic identity conditions for her persisting as one and the same entity (object) are shared by all living organisms. The natural kind tiger therefore shares diachronic identity conditions with other natural kinds in the category of living organisms but it has different sortal persistence conditions. According to Lowe, diachronic identity conditions are known *a priori*, whereas our knowledge of sortal persistence conditions is *a posteriori* because they are given in connection with our *a posteriori knowledge* of natural kinds.⁸

Thus, according to Lowe, the objects belonging to the distinct natural kinds of living organisms or, for instance, material objects still belong to the same most specific category and have the same identity conditions. Thus, it is metaphysically possible, for instance, that a tiger persists as the same entity even if she did not persist as a tiger. It is metaphysically possible that she would turn into a lion, for example. It is also metaphysically contingent that she is a tiger. Similarly, since atoms belong to the same most specific ontological category, it is metaphysically possible that a carbon-14 atom turns into a nitrogen-14 atom (provided that this accords with the correct account of the identity conditions of atoms). In general, objects have the same identity conditions if they belong to the same most specific ontological category but different natural kinds in the category. This leaves room for the metaphysical possibility of kind change.⁹ We will argue in the next section, by making two plausible modal

⁷ According to Lowe, categories are not (individual) entities but rather pluralities of entities sharing certain formal ontological features. Therefore, the plural form is more accurate when we speak about categories, cf. Lowe (2006a, 38ff.).

⁸ Lowe 1998, 185. Lowe re-affirms later the view that knowing categories of entities and the associated identity conditions of objects is a purely *a priori* matter, cf. Lowe (2006b, 2014, sec. 6). This might be considered as a fairly radical position with respect to knowledge of such categories (or general kinds) as living organisms.

⁹ Nevertheless, in some cases, the identity conditions of objects belonging to some ontological category might set strict constraints on kind change, which are not fulfilled by any actual entities of the category. Elementary micro-particles (if considered as objects) might be such entities.

assumptions, that the possibility of kind change entails that the relation of instantiation holds contingently relative to existence of relata.

2.2 The necessity of instantiation

Instantiation is one of the two basic formal ontological relations in Lowe's Four-Category Ontology. This gives him very strong reasons to assume that instantiation holds necessarily if the relata of this relation exist.

According to Lowe (2006a, 114), the basic formal ontological relations of *instantiation* and *characterization* between an entity and some distinct entities uniquely determine to which of the four general categories the entity belongs. Thus, what is for an entity to be *substance* is determined by the fact that it instantiates some *kinds* and is characterized by some *modes*. These basic formal ontological relations are *internal relations* (as distinctness, for instance, is). In Lowe's terms, instantiation is an "internal relation" because the existence of the entities connected by it is sufficient for instantiation obtaining (Lowe 2006a, 167; 2012, 241-2). This view of instantiation has two consequences that are relevant for the present purposes.

The first consequence is a principle that may be called 'NBF' (necessity of basic formal ontological relations). NBF states that it is metaphysically necessary that if the *relata* of a basic formal ontological relation exist, the basic formal ontological relation obtains. So according to Lowe, as a basic formal ontological relation, instantiation holds metaphysically necessarily given the existence of its relata.¹⁰ Secondly, instantiation is not itself any kind of relational entity (a member of some of Lowe's four categories). The formal ontological relation of instantiation holds simply because of the existence of the two related entities, say *a* and *b*. Similarly, entities *a* and *b* are truthmakers of the proposition (or, the relational

¹⁰ Let "E!" be the predicate of existence, "Inst" the predicate of instantiation, "e" denote some object *e* and "k" some kind *k*, which the object instantiates. Hence, as expressed in modal predicate logic, the following holds: $\Box((E!e \wedge E!k) \rightarrow \text{Inst}(e, k))$. The principle that the existence of a truthmaker necessitates the truths it makes true is fairly widely accepted, cf. e.g., Lowe 2012. NBF (as applied to formal ontological predications) has independent motivation although it would also be a consequence of the more general principle that the existence of a truthmaker necessitates the truths it makes true.

formal ontological predication) that *a instantiates b*.¹¹

According to Lowe, modes instantiate attributes (property universals). Consider a redness mode (i.e. particular redness) of some rose or a one kilogram mode of an iron ball. Given that this redness mode exists, it instantiates the corresponding attribute, the property universal of redness. Similarly, given that the one kilogram mode exists, it instantiates the property universal of the mass of 1kg. The iron ball has the property of the mass of 1kg, that is, it *exemplifies* that property universal because the ball is *characterized* by a one kilogram mode that *instantiates* the property universal. Lowe analyses objects' having all of their contingent properties in a similar manner

Thus, the redness mode is *by its very nature* (or, 'essence') a redness mode and a one kilogram mode is by its nature a one kilogram mode. In general, because of being entities they are, modes instantiate the corresponding property universals; there is no need to postulate any other entities (cf. Lowe 2012, 242). Hence, it is *necessary to modes* that they instantiate the respective property universals.¹²

The same result can be generalized to substances and the kind universals they instantiate. First, according to Lowe, every particular object is necessarily an instance of *some* kind. Second, by NBF, necessarily, if an object and the substantial kind it actually instantiates exist, the object instantiates the kind at issue. Third, and even more strongly, the definite kind which an object instantiates is necessary to that object. *Any* particular object is connected to a definite natural kind by the formal ontological relation of instantiation:

“[A]n object *necessarily* instantiates its kind and that a mode *necessarily* instantiates its attribute, both of which claims are *prima facie* highly plausible.” (Lowe 2012, 242)

The best explanation Lowe can give to this is that all objects have a specific nature (or, essence) in virtue of which they are instances of some specific kind K. For instance,

¹¹ Cf. Lowe 2006a, 44-47, 59. For a further discussion of formal ontological relations, see Smith & Mulligan (1983), Correia & Keller (2004) and the other articles in the same issue of *Dialectica*.

¹² Let “m” denote some mode *m* and “k” property universal *k* which *m* instantiates. Hence, as expressed in modal predicate logic, the following holds: $\Box((E!m \rightarrow \text{Inst}(m, k)))$.

electrons, helium-4 isotopes or water molecules belong to the respective natural kinds (electron, helium-4 atom, water molecule) in virtue of their being the objects they are. Hence, the formal ontological relation of instantiation holds between particulars (substances or modes) and their kinds because particulars are what they themselves are (they have a specific nature).¹³ Instantiation is grounded in the *essence* of particulars, that is, in what these particulars are¹⁴:

“Similarly, it is very plausibly *part of the essence* of a particular horse, Dobbin, that he is an instance of the kind *horse*.” (Lowe 2012, 242)

In Lowe’s Four-Category Ontology, both substances and kinds are entities of a fundamental category. Therefore, substances and kinds are also *basic truthmakers* of the claims of objects instantiating kinds, and they cannot be made true by anything else (e.g., an object having modes).¹⁵ By contrast, exemplification is a derived formal ontological relation and it is necessary or contingent (relative to the existence of the object) depending on whether it is analysed by means of objects instantiating kinds or objects being characterized by certain kinds of modes (Lowe 2012, 244).¹⁶

This view of instantiation as a basic formal ontological relation grounded in the essence of objects and Lowe’s Neo-Aristotelian ontology which identifies natural kinds with kind universals, jointly rule out the metaphysical possibility of kind change. Kind change would mean that object *a* first belongs to some natural kind *K* and then ceases to be its member by becoming a member of a distinct kind *K’*. On the basis of two plausible modal assumptions, we can now argue that the possibility of kind change entails that the relation of instantiation

¹³ Cf. Lowe 2012, 241-244. Lowe’s example is a particular horse (Dobbin), which instantiates the kind horse and exemplifies the essential attributes of the kind in virtue of its essence. However, Lowe (2006a, 116) maintains that objects are rigidly existentially dependent (only) on the “highest kinds” they instantiate.

¹⁴ Lowe does not consider the essence of an entity separate being (or entity distinct from the original entity) but rather indicating what the entity is, cf. Lowe 2006b, sec. 1 and 2014, 98.

¹⁵ Similarly, Lowe (2015, 21) argues that the substantial kind electron is a basic truthmaker of the statement that electrons are negatively charged. The kind electron is a truthmaker of that statement and it is the most fundamental entity making that statement true.

¹⁶ To be precise, Lowe does not employ the term “derived formal ontological relation” of exemplification. However, he speaks about exemplification as a “derivately” obtaining formal ontological relation between objects and attributes (2006a, 125). Therefore, we are entitled to use the term “derived formal ontological relation” when describing exemplification in Lowe’s system.

holds contingently given the existence of its relata (object *a* and kind universal *K*).

Assume that object *a* changes its natural kind from *K* to *K'* (e.g., Dobbin the horse becomes a tiger). First, object *a* could have existed for a shorter period and been a member of either of these kinds (*K* or *K'*). Second, the existence of kinds (i.e., kind universals) *K* and *K'* is metaphysically independent of their having any *particular* object as their instances. Therefore, (by using the convenient talk about possible worlds) there is a possible world in which *a* exists and is instance of either (but not both) of kinds *K* or *K'* and in which both of these kinds exist. In such a world, *K* or *K'* is instantiated by some other object than *a* (e.g., Dobbin is not a horse but tiger, but there are some other horses). Consequently, the relation of instantiation holds contingently between *a* and *K* relative to the existence of *a* and *K*.

As we noted just above, Lowe adopts two claims concerning metaphysical necessity of instantiation. According to stronger claim, necessarily, if a definite object or mode exists, it is an instance of some definite kind or attribute (cf. note 12).¹⁷ The weaker claim is: necessarily, if definite object *i* and definite kind *K*, which the object actually instantiates, exist, then object *i* instantiates kind *K* (cf. NBF and note 10). The weaker claim is required to preserve the conception of instantiation as one and the same basic formal ontological relation between particulars (*objects* and *modes*) and universals (*kinds* and *attributes*). According to Lowe, the stronger claim also holds because the obtaining of the relation of instantiation is grounded in the essences of objects and modes. Either of these claims (stronger or weaker) suffice to rule out the metaphysical possibility of kind change.¹⁸

In closer inspection, an advocate of Four Category Ontology, who adopts NBF and the weaker claim, is also driven to adopt the stronger claim. The existence of any attribute or kind is metaphysically independent of the existence of its particular instances. Thus, it is *contingent* to *every* kind or attribute that it is instantiated by some definite object or mode. Nevertheless, the relation of instantiation holds necessarily (given the existence of its relata). Therefore, the instantiation of a specific kind or attribute must be necessary to a particular

¹⁷ Thus, the formula in note 12 holds for an object (=m) and the kind (=k) the object instantiates.

¹⁸ The stronger claim rules out kind change without need for making any additional modal assumptions about the existence of kind *K* (cf. the second assumption just above). Necessarily, if kind *K* is instantiated by object *a*, then *K* exist. Thus, the stronger claim also makes an object is *rigidly dependent* on some definite kind *K*.

object or mode. If instantiation were contingent to an object, we could construe a possible world in which the object and the kind which the object actually instantiates both exist, but the object does not instantiate the kind.

By relying on the stronger claim, Lowe can rule out bare particulars, in the sense of objects without metaphysically necessary properties, as an important extra benefit. According to Lowe, every object exemplifies metaphysically necessary attributes that characterize the natural kind(s) the object instantiates (Lowe 2006a, 62; 2012, 244).

Lowe's views lead to contradictory conceptions concerning the necessity/contingency of instantiation relation given the existence of its relata (objects and kinds). Hence, we can ask which of these considerations are more important for Lowe's ontological system. In our view, the answer is clear. The most basic assumptions of Lowe's Four-Category Ontology include the conception of instantiation as a basic formal ontological relation and a metaphysically necessary relation (given the existence of the relata). The considerations presented in the previous section for the contingency of instantiation concern more specific categories of entities, which already presuppose the four-category scheme. Therefore, they bear less weight.

3. Instantiation and kind change

Although having claimed that instantiation is a metaphysically necessary relation relative to the existence of its relata, Lowe (2014, 14-19) continues to advocate the distinction between identity conditions and sortal persistence conditions. Behind this, there is the plausible observation that the identity conditions of objects do not seem to rule out kind change. *Prima facie*, objects obtain their identity conditions on a more general level than specific natural kinds and many objects belonging to the distinct natural kinds (e.g., different living organisms, atoms, etc.) appear to have the same identity conditions. For this reason, there are possible or (on a plausible interpretation) actual examples of an object changing its natural kind.

The advocate of Lowe's Four-Category Ontology, who is obliged to rule out kind change for the reasons laid down in the previous section, should resist this conclusion. In the present section, we argue that she has two fairly awkward alternatives. Both of these alternatives are based on the idea that kinds are necessary to the objects instantiating them, which Lowe also adopts in his later articles (cf. the previous section). First, the advocate of Four-Category Ontology might bite the bullet and stick to the necessity of each of the most specific natural kind to the object instantiating it. The second option is to maintain that there are in fact only very general natural kinds. All more specific kinds are entities belonging to some derived category or our constructions but are not natural kinds identified with kind universals. In the following sub-sections, we will assess both of these alternatives in turn.

3.1 Kind Changes as Substantial Changes

Thus, according to the first option, all natural kinds are (as kind universals) necessary to their instances. No object can begin its existence as a certain kind of object and then continue to exist as a member of a different natural kind. All alleged cases of kind change must be considered *substantial changes*: as examples of destruction of an object and its replacement by a distinct object.

Nevertheless, this straightforward suggestion encounters serious problems. There are actual empirical cases that may be *plausibly* interpreted as examples of kind change. In them, an object that belongs to a specific kind that is a sub-kind of a more general kind seems to change its specific kind but it still continues to exist as a member of the same general kind. The number of the members of the general kind is neither diminished nor increased. Moreover, if considered a complex entity, the object changing its specific kind retains its central proper parts arranged in a certain way, which can identify it through change.

As a plausible example, consider β^- decays, in which the total charge of an atomic nucleus increases by the emission of an electron and an electron neutrino. An instance of this is the decaying of a carbon-14 atom into a nitrogen-14 atom. *Prima facie*, one and the same

atom persists through this process but the atom changes its natural kind from a carbon-14 atom into a nitrogen-14 atom: first, the total number atoms (i.e., the members of the general kind) is not altered. Second, the atom changes its nuclear charge and natural kind because one of the nucleons changes from a neutron into a proton. Nevertheless, the total number of its nucleons remains the same.¹⁹

Similarly, one might claim, although this is more contestable, that elementary micro particles are examples of objects changing their natural kind while remaining in existence. For example, d-quarks turn into u-quarks in β^- decays but the number of the members of the general kind (i.e., quarks) remains the same.²⁰ Furthermore, it appears that the different kinds of molecules (such as water molecules) can temporarily lose some of their proper parts (hydrogen atoms) and thus temporarily cease to be the specific kind of objects they are but still continue to exist.

There is at least some room for reconsideration in all of these examples, whether they are (and in what conditions) examples of kind change. It seems difficult to have a comprehensive account of the identity conditions of objects solely by means of empirical considerations; we need some general metaphysical principles on the basis of which we deem the above cases as instances of persistence and kind change.

Lowe's (1998) answer is to introduce the *a priori* given *identity conditions* of an object to guide our understanding of its persistence (cf. section 2.1). He uses the distinction between *identity conditions* and *sortal persistence conditions* of an object to explicate the determination of identity conditions of objects as members of natural kinds. Objects belonging to a certain most specific category have certain *a priori* knowable identity conditions, whereas the natural kinds of objects are discovered empirically. Kind change is *metaphysically possible* among the objects belonging to a single category, but it depends on

¹⁹ Ellis (2001, 238) comments the same example: “[t]here is a powerful continuity argument to suggest that as an individual, the former atom still exists, but now as an atom of another kind.”

²⁰ If considered single entities, quarks drastically change their central properties (such as mass and electric charge) in β^- decays. However, as in the atomic case, there is a one-to-one replacement of a particle belonging to a general kind (quark) with a particle of the same general kind (another kind of quark).

empirical details whether there are actual cases of kind change in that category.²¹ Hence, the distinction gives a principled support for the observation that certain empirical cases are best considered as events in which a single object changes its natural kind.

It is a core feature of Lowe's distinction between identity conditions and sortal persistence conditions that the identity conditions of objects in distinct categories allow for kind change. As a consequence, in many cases, instantiation is a metaphysically contingent relation relative to the existence of its relata, i.e., substances and kind universals (cf. section 2.2.). Moreover, many (if not all) substantial natural kinds are contingent to the objects instantiating them. These claims are, of course, inconsistent with the general conception of instantiation as a basic formal ontological relation, which entails that it holds necessarily given the existence of its relata, particulars (objects and modes) and universals (kinds and attributes).

Conversely, the general conception of instantiation as a basic formal ontological relation together with plausible modal assumptions (cf. section 2.2) entails that every substantial natural kind that is instantiated by an object, most specific and most general in hierarchical order, is necessary to it. No object can persist when it changes its kind and every putative kind change is actually a substantial change. Therefore, considering instantiation a basic formal ontological relation has the unfavourable consequence that Lowe's distinction between *diachronic identity conditions* and *sortal persistence conditions* collapses. Every object has only diachronic identity conditions, which are directly provided by the most specific kind universal the object instantiates.

The collapse of the distinction between diachronic identity conditions and sortal persistence conditions entails that all examples of an object changing its natural kind must be re-interpreted as substantial changes. Take, for instance, the above example of decaying of carbon-14 atoms into nitrogen-14 atoms or water molecules temporarily losing one of their constituent hydrogen atoms. This is a significant cost for Lowe's Four-Category Ontology.

For Lowe, the theoretical price of this collapse is even higher. According to a currently

²¹ Lowe 1998, 183-4. Cf. also Ellis 2001, 239.

widely accepted view, which Lowe also adopts, we come to know the specific natural properties and natural kinds by empirical means. Because the sortal persistence conditions of objects are also their identity conditions, the latter are given in connection with the specific natural kinds. Hence, the advocate of Four-Category Ontology must adopt the view that the identity conditions of objects are known *a posteriori*. There would be no such thing as the *a priori* known *fundamental general essences* determining the identity conditions of objects. We could not know the identity conditions of objects *a priori* by pure rational discourse. This jeopardizes Lowe's conception of metaphysics as an *a priori* study of the identity and existence conditions of entities determined by their fundamental general essences: as the science of essence “[w]hose epistemic basis and status are entirely akin to those of mathematics and logic, differing from both of the latter primarily in having formal ontological questions at its heart” (Lowe 2006b, 1). Moreover, according to Lowe, we can think and talk about an object only if we have some *a priori* knowledge of its identity conditions (Lowe 2006b, sec.2). The *a posteriori* character of the knowledge of identity conditions would make our ability to think and talk about objects, at least by Lowe's own lights, a miracle.

3.2 Natural Kinds as Restricted to General Kinds

The second option for the advocate of Four-Category Ontology is to accommodate the contingency of many specific *prima facie* natural kinds by considering them derived *subsorts* of natural kinds. As sub-sorts, they would not be entities (e.g., kind universals) but rather pluralities of objects picked up by the derived kind terms (cf. Lowe 2009, sec.12). Also this view retains the necessity of the instantiation relation between objects and kind universals given the existence of relata. In many cases, only very general kinds (e.g., atom) are real examples of natural kinds, that is, natural kinds identified with kind universals. We could allow for kind change in the case of specific kinds if they were considered derived sub-sorts of natural kinds.

As a reply to the problems taken up in the previous section, it would be a *prima facie* promising option for the defender of Four-Category Ontology to adopt the strategy just outlined, which we call *the sub-sortal strategy*. It consists of two steps. The first step is to deny that certain alleged natural kinds (e.g., carbon-14 atom) are genuine natural kinds. According to Lowe's philosophy of language in *More Kinds of Being* (2009), all terms designating genuine natural kinds are semantically simple kind terms. Semantic simplicity does not always go hand in hand with syntactic simplicity: Lowe's example is, on the one hand, "ice", which he regards as semantically complex and not a designator of a distinct kind and, on the other hand, "heavy water" that is semantically simple (its semantics is not determined compositionally by the semantics of "heavy" and "water") and designates a distinct kind of chemical substance, namely D₂O (2009, 31). The semantically complex "kind terms" do not refer to kind universals. They are, as Lowe (2009, 30,188) puts it, complex sortal terms, which can be analysed into a natural kind term, which refers to a kind universal, and predicative expressions attributing certain further features to the object.

All "kind terms" allegedly designating natural kinds contingent to their instances are now taken as complex sortal terms. Using our example above, "a carbon-14 atom" is taken as shorthand for something of the form "an atom which has the nuclear mass *m* and nuclear charge *n*". Hence, the specific mass *m* and nuclear charge *n* would not characterize the natural kind to which carbon-14 atom *a* belongs (i.e., atom) but rather just the atom *a* itself. In terms of Lowe's (2006a, 2009) Four-Category Ontology, atom *a* would possess these properties *occurrently* (by possessing the respective modes) rather than *dispositionally* (by being an instance of a kind characterized by these property universals).²²

The second step of the sub-sortal strategy is to reject the claims of contingency of any natural kind identified with a kind universal to its instances. Continuing the above example, the defender of Four-Category Ontology would maintain that only the general kind (the kind atom) but not the specific kind is a kind universal and necessary to its instances. *The sub-*

²² Lowe (2009, 188ff.) presents similar examples of complex sortal terms picking up sub-sorts of kinds, e.g., ravens having some abnormal genetic condition. However, he does not deploy them for the purposes considered here.

sortal strategy would be a combination of these two steps. Since every object is necessarily an instance of some natural kind, the defender of Four-Category Ontology attempts to find out for every object a (sufficiently general) natural kind to which it necessarily belongs (which it cannot change). If some more specific "kinds" are contingent to their instances, they would be *derivative sub-sorts of kinds*: only groups of objects picked up by the complex sortal terms. However, such sub-sorts of kinds would not be unitary constituents of reality (entities). In other words, sub-sorts would not be substantial universals instantiated by objects, that is, natural kinds as Lowe considers them.

If many specific *prima facie* natural kinds turn out to be derivative sub-sorts of kinds (as it seems), it is a pressing issue for the sub-sortal strategy to be able to specify the natural kinds, which would be identified with kind universals. There are two types of possible candidates. First, if we restricted our discussion to elementary particles, atoms and molecules, it might well be a plausible suggestion that at least some general kind is necessary to each of them. Thus, for instance, atoms would bear the formal relation of instantiation to the kind atom and molecules to the kind molecule.

Second, in his article titled *In Defence of Substantial Universals* (2015), Lowe applies Four-Category Ontology to elementary particles. He seems to consider the specific natural kinds of elementary particles (e.g., electron and down quark) as kind universals. As kind universals, they both act as truthmakers of certain fundamental laws of nature and collect the properties essential to a certain natural kind such as electron (Lowe 2015, sec.6).²³ In order to make this suggestion work, one must consider these specific natural kinds necessary to their instances (cf. section 3.1).

It is difficult to specify further good examples of natural kinds considered kind universals and necessary to their instances. If the general claims about the identity conditions of objects presented in section 3.1 are on the right track, such standard *a posteriori* examples

²³ However, in *The Possibility of Metaphysics* and *The Four-Category Ontology*, Lowe maintains that elementary particles are quasi-objects since they do not have determinate identity-conditions (Lowe 1998, 62ff.; 2006a, 75). On this view, their kinds cannot be genuine natural kinds because genuine natural kinds are substantial kinds of objects for Lowe. This forces one to suspect that kinds of elementary particles are not natural kinds for Lowe at the end of the day.

of *prima facie* natural kinds like atomic isotopes (e.g., the kind of carbon-14 atoms) or elements would not meet the strict standards set to natural kinds. Similarly, there is no reason to expect that the specific kinds of more complex objects (e.g. living organisms) would satisfy them either.²⁴ Moreover, claiming that any of these specific kinds is a kind universal and necessary to its instances would amount to a partial acceptance of the thesis that the changes of the specific kinds are substantial changes, a problematic move which the sub-sortal strategy is meant to avoid.

Thus, by adopting the sub-sortal strategy, the advocate of Four-Category Ontology is driven to the view that *there are in fact very few natural kinds*: only micro-particles would perhaps instantiate specific natural kinds considered as kind universals, whereas the specific kinds of all more complex objects must be reconsidered as sub-sorts.

This is a problematic conclusion from the point of view of Lowe's Four-Category Ontology. Lowe advertises Four-Category Ontology by the four important functions natural kinds identified with kind universals can perform. Here, it suffices to take up three of them.²⁵ First, Lowe (2009, ch.2) considers kinds the *designata* of the primitive natural kind terms. Second, kinds collect the essential properties of a natural kind. Third, kinds act as the truthmakers of law statements concerning the members of a natural kind.²⁶ According to Lowe, kinds are the best candidates for the entities performing these functions and the other rival category systems (e.g., trope theories or the realist ontologies not introducing kind universals) are not well-equipped to accommodate these tasks.

The first problem with the sub-sortal strategy is that it would seriously weaken the capability of Four-Category Ontology to do its much-acclaimed metaphysical work. Since the sub-sorts of kinds are not entities, they cannot perform any of the three functions outlined in

²⁴ Lowe's own remarks about identity conditions of organisms (cf. sect. 2.1) strongly suggest that the specific kinds of organisms are not necessary to their instances. Also the other well-developed essentialist theories of the identity-conditions of such complex objects as organisms (cf., e.g., Wiggins 2001) suggest that only some very general kinds are necessary to them. No claims about the necessity of the specific kinds (e.g., definite species - assuming that they can be considered natural kinds) is made.

²⁵ As the fourth function, by being instantiated by objects, kinds provide a partial account of the particular-universal distinction (Lowe 2015, sec.5).

²⁶ For Lowe (2006a; 2009; 2015), the last two functions are closely interconnected. It is kinds that are supposed to explain that the world contains certain kinds of objects with certain essential properties and that certain laws are true of these objects (Lowe 2006a, 134-136; 2015, sec.6).

the previous paragraph. There would be no kinds to perform the unifying function of collecting essential properties of specific natural kinds of complex objects (e.g., water molecule or tiger). Kinds introduced (e.g., atom) would be general kinds and unsuitable for this job. Similarly, there would be no kinds acting as truthmakers of the different laws of nature about these complex objects (e.g., laws about chemical reactions of specific kinds of molecules).

By introducing such kinds as down-quark or electron (i.e., kind universals identified with the specific natural kinds of elementary particles), the advocate of Four-Category Ontology would be able to have entities performing these functions in the case of elementary particles belonging to a specific kind (collecting their essential properties, for instance). Nevertheless, Lowe's standard examples are specific natural kinds of complex objects such as biological organisms. Hence, other entities than just elementary particles have specific kind essences and figure in laws of nature. Thus, allowing for kind universals identified with specific kinds of micro-particles is insufficient for his purposes.

Moreover, after adopting the sub-sortal strategy, the advocate of Four-Category Ontology cannot formulate a simple semantics for the most *bona fide* natural kind terms, according to which kind terms would denote kind universals. Kind terms picking out most of the specific kinds would be derived kind terms. Hence, the advocate of the sub-sortal strategy cannot advertise her view by its ability to deliver a straightforward referential semantics for all natural kind terms.

The second major problem with the sub-sortal strategy is the collapse of the distinction between diachronic identity conditions and *a posteriori* known sortal persistence conditions of objects. Recall that, on Lowe's official view, the identity conditions of objects are determined by their fundamental general essences determining their most specific category. According to Lowe (1998, 184), categories such as living organisms are not natural kinds, which are universal *unitary* entities, but mere formal ontological ways to classify *pluralities* of entities. Since the natural kinds which the sub-sortal strategy introduces are necessary to their instances, the distinction between identity conditions and sortal persistence

conditions collapses. If we come to know kind universals by empirical means (which seems to be the only reasonable option), there is no such thing as *a priori* known identity conditions of objects. This would again jeopardize Lowe's conception of metaphysics as an *a priori* study of identity and existence conditions of entities.

It seems that the sub-sortal strategy is even a worse option for an advocate of Four-Category Ontology than considering the specific natural kinds necessary to objects. Both of these strategies would lead to the rejection of Lowe's doctrine of the *a priori* known identity conditions of objects. Restricting natural kinds to general kinds of complex objects would perhaps satisfy the intuition that certain identity conditions are shared by all members of a general kind. Nevertheless, in the context Lowe's Four-Category Ontology, this restriction would lack any further motivation. There would not be enough kind universals (specific kinds of organisms and other complex objects) to perform the important functions Lowe wants to assign to natural kinds.

4. Conclusion

Instantiation is one of the two basic formal ontological relations in Lowe's Four-Category Ontology. We argued in section 2 that since instantiation is a basic formal ontological relation, it is a metaphysically necessary relation relative to the existence of its relata. This is also the conclusion Lowe (2012, 2015) explicitly draws on the same grounds. The metaphysical necessity of instantiation rules out, on certain plausible modal assumptions, the metaphysical possibility of kind change. Nevertheless, ruling out of the possibility of kind change is very problematic in the case of substantial natural kinds: the identity conditions of objects seem to be determined in a more general level than specific natural kinds and there seem to be actual examples of an object changing its natural kind.

The advocate of Four-Category Ontology may attempt to solve this problem in two alternative ways. Both of them are unsatisfactory. The first is to identify all *prima facie*

substantial natural kinds with kind universals and consider them necessary to their instances. As a consequence, Lowe's distinction between identity conditions and sortal persistence conditions of objects collapses (sec. 3.1). Every kind change (change of natural kind by a single object) must be reinterpreted as a substantial change (destruction of an object and generation of a new object). Moreover, if one adopts this alternative, one must reject Lowe's conception of metaphysics as an *a priori* study of the existence and identity conditions of objects determined by their fundamental general essences.

The second alternative is to consider all natural kinds contingent to objects derivative sub-sorts of natural kinds, which is the *sub-sortal strategy* (sec. 3.2). The latter would be more general kinds and kind universals necessary to their instances. Also the sub-sortal strategy leads to the collapse of the distinction between identity conditions and sortal persistence conditions important to Lowe's general conception of metaphysics. Nevertheless, the main problem is that sub-sorts are not unitary entities, but mere pluralities of objects. Thus, they cannot do any of the work assigned to kind universals (e.g., collect the essential properties of natural kinds). If we introduce sub-sorts at some level of complexity to accommodate the contingency of the specific natural kinds to objects, there are no corresponding kind universals and Four-Category Ontology does not have the claimed explanatory benefits at that level. Therefore, adopting sub-sortal strategy foils Lowe's attempt to provide a comprehensive theory of natural kinds applicable to the kinds of objects at the different levels of complexity, which is his explicit goal in both the *Possibility of Metaphysics* and in the *Four-Category Ontology* (1998, ch. 8; 2006a, ch. 9).

The results of this article have a more general significance in assessing certain recent Neo-Aristotelian four- or six-category ontologies (Lowe 1998, 2006a, 2009; Ellis 2001). In them, both modes and substances are connected to their kinds by exactly the same formal ontological relation of instantiation. As a single formal ontological relation it must have a definite grounding, namely, in the nature (or essence) of the particular. Consequently, it must hold necessarily given the existence of the particular: objects and modes must already "select" the natural kinds to which they belong. *Pace* Ellis (2001, 237-241), the advocates of

these Neo-Aristotelian category systems cannot keep individual essences separate from kind essences. Moreover, there is no room for kind change if we want to identify natural kinds with kind universals.

References

- Armstrong, D.M. (1989): *Universals - an Opinionated Introduction*, Boulder, Westview Press.
- Armstrong, D.M. (1997): *The World States of Affairs*, Cambridge, Cambridge University Press.
- Bergmann, G. (1967): *Realism - a Critique of Brentano and Meinong*, Madison, The University of Wisconsin Press.
- Correia, F. & Keller, P. (2004): Introduction, *Dialectica* 58, 3, 275-278.
- Ellis, B. (2001): *Scientific Essentialism*, Cambridge, Cambridge University Press.
- Lowe, E.J. (1998): *The Possibility of Metaphysics – Substance, Identity and Time*, Oxford, Clarendon Press.
- Lowe, E.J. (2006a): *The Four-Category Ontology – A Metaphysical Foundation for Natural Science*, Oxford, Clarendon Press.
- Lowe, E.J. (2006b): “Metaphysics as the Science of Essence”, manuscript.
- Lowe E.J. (2009): *More Kinds of Being – A Further Study of Individuation, Identity and the Logic of Sortal Terms*, Oxford, Wiley-Blackwell.
- Lowe E.J. (2012): “A neo-Aristotelian Substance Ontology – Neither Relational nor Constituent”, in Tuomas Tahko (ed.), *Contemporary Aristotelian Metaphysics*, Cambridge, Cambridge University Press, pp. 229-248.
- Lowe E.J. (2014): *Forms of Thought – a Study in Philosophical Logic*, Cambridge, Cambridge University Press.
- 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, pp. 65-84.

Smith, B. (1997): “On Substances, Accidents and Universals: In Defence of a Constituent Ontology”, *Philosophical Papers* 26, 105-127.

Smith, B. & Mulligan, K. (1983): Framework for Formal Ontology, *Topoi* 2, 73-85.

Wiggins, D. (2001): *Sameness and Substance Revisited*, Cambridge, Cambridge University Press.